Midwest Engineer

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THE ROLE OF THE RAILROADS—PAGE THREE
WSE MEETINGS—PAGE TWO

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GENERAL AND EDITORIAL OFFICES
HEADQUARTERS OF
WESTERN SOCIETY OF ENGINEERS
84 E. RANDOLPH STREET
CHICAGO 1, ILLINOIS
TELEPHONE: RANDOLPH 6-1736

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Cover Story

The next-door neighbor of the Western Society of Engineers is the John Crerar Library. This unique library has no children's books, novels, or any other non-scientific or non-technical books. Credited with being one of the primary forces in the development of Chicago, the Crerar Library has 700,000 volumes on its shelves, and receives 15,000 magazines regularly to place on its racks. Crerar handles about 350,000 calls each year for books, and produces the desired book, on the average, in less than four minutes.

December 8, General Meeting

Speaker: John G. Greenwood, Engineer with Ingersoll-Rand Company, Chicago, and Special Representative to Industry.
Subject: "Turbo-Blowers are Your Business."
The use of turbo-blowers in industry even now is extensive. Their use, however, is steadily increasing, and the indications are that this increase will continue. The members of WSE are bound to come into closer contact with turbo-blowers, and this talk, therefore, should be quite interesting.

December 10, Professional Women's Council

This will be their Christmas party, guaranteeing fun for all. The get-together will be at 5:30, dinner at 6:00. The Christmas party proper will begin at 7:30 P.M. in WSE's lounge. An engineer's version of a combined "What's My Line-Twenty Questions" game under the emceeship of Margaret Griesel assures the same fun which was had at the last two jamborees. Of course, all WSE members are invited.

December 15, Electrical Section

Speaker: L. P. Works, Distribution Engineer, Wisconsin Public Service Corporation, Green Bay, Wisconsin.
Subject: "Movement of Overhead Conductors due to Flow of Fault Currents."

Burn-down of overhead line conductors due to the flow of fault current has long been a matter of considerable concern, particularly to utility engineers, because the reasons for these failures have been obscure. Mr. Works will present the results of full scale tests, for which he has been responsible, to show the behavior of line conductors under the extreme electromagnetic forces set up by large fault currents. These results were obtained by taking high-speed motion pictures under various test conditions to catch the violent conductor movements. The showing of these pictures at normal speed clearly demonstrates why conductor burn downs are experienced. Comments on the test results will cover the measures which might be taken to avoid this cause of interruptions to electric service with its attendant costly repairs; and the reasons why fast clearing of faults with not-so-fast reclosing of circuit breakers is necessary.

December 17, Junior Division

Speaker: Phil Hanna, noted business columnist of the Chicago Daily News.

Subject: "Current Business Problems and how they Relate to the Young Engineers of the Community."

Mr. Hanna is an authority in the field of business and finance. A man of great vision and with faith in the potentialities of youth in our community, he became the first president of Junior Achievement. The results of this program are exemplified by the junior industrialists of today and the citizens of tomorrow who have a vivid concept of the American Way of Life. All members of WSE are invited to attend.

December 22, General Meeting

This meeting date has been cancelled due to its nearness to the holiday season.

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The Role of The Railroads

By Fred G. Gurley

It is always difficult to determine with a high degree of accuracy the so-called first about anything. I think it is generally agreed, however, that the first railroad in the sense in which the word is used today was the Stockton and Darlington Railway in England which was completed in 1825. The idea caught on, and within a relatively short time a substantial number of steam railways were in operation on the continent of Europe, in Great Britain, and in this country.

Because time does not permit review of rail transportation on a world-wide basis, I shall direct my remarks to the American railroads. I think this is appropriate not only because my closest familiarity is with our own system, but because the growth of rail transportation in this country affords a theme which I want particularly to emphasize.

The important role of the railroads in the development of the United States can be more fully appreciated when we recall that the future of this new nation depended upon making a success of an experiment in government, and that that great accomplishment depended in no small part upon finding an answer to the problem of communication and transportation. While it may not have been immediately apparent, surely the problem required finding a better answer than could be provided by the historic use of roads and waterways.

With the execution of the peace treaty in 1783, a new nation with a relatively small population living along the Atlantic Seaboard held title to a territory extending to the Mississippi River, some 1000 miles to the West. There were only rough trails across the mountain ranges to the vast area which became known as the Northwest Territory under the famous ordinance of 1787. This ordinance was passed by the Continental Congress prior to the adoption of our constitution.

The Northwest Territory comprised the region lying north and west of the Ohio River, south of the Great Lakes and East of the Mississippi. Ohio, admitted to the Union in 1803, was the first of the five states which were created out of the Northwest Territory.

The transportation of the commerce to and from this vast area was provided in large part by vessels on the Ohio and Mississippi Rivers. Movement via Natchez and New Orleans was through territory controlled by a foreign power. The whole valley of the Ohio was dependent upon the permission of a foreign power for an outlet to the Gulf. Trade restrictions and impositions upon river traffic became unbearable. This included confiscation of vessels, of cargoes, and imprisonment of crews.

In response to a feeling of general indignation, President Jefferson sent James Monroe to France with instructions to negotiate the purchase of territory which controlled movement on the Mississippi River. As it turned out, Monroe purchased the entire area controlled by France throughout the length of the Mississipi and which, in the central and northern sections, extended to the Continental Divide.

The interesting part of all this in connection with our discussion is that it was the need to control an important artery of transportation which caused us to make the Louisiana Purchase. Without those lands it is clear that our subsequent expansion to the Pacific Coast, including the Republic of Texas, could not have been consummated.

The expansion beyond the western limits of the Louisiana Purchase to the Pacific Coast was accomplished first by an arrangement with Great Britain in 1818 for the joint control of Oregon. By 1848, California and New Mexico had been acquired, as had the State of Florida. Texas had been annexed and the United States had complete control of Oregon. The nation extended some 3,200 miles from the Atlantic to the Pacific.

The necessity for the best possible comunication and transportation manifested itself quite early in our country's history. One of the first problems related to transportation between the Eastern Seaboard and the Ohio Valley.

In 1806, President Jefferson signed the bill which authorized building the National Road which started at Cumberland, Maryland. This road greatly facilitated the movement of commerce and aided in the development of the Ohio Valley, although its rate of construction was slow, and by the time it reached the Indiana-Illinois state line, about 1850, railroads were being built in many places and meeting with public favor.

Oddly enough, probably the greatest

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Fred G. Gurley, President, Atchison, Topeka and Santa Fe Railroad, Chicago, gave this address before the Transportation Symposium of the Centennial of Engineering in Chicago on September 8, 1952.

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stimulant to the construction of railroads was the Erie Canal. Construction of the Erie Canal began in 1817 and it was completed by the State of New York in 1825. This canal made it possible to move by barge from Lake Erie to the Hudson River. This provided the City of New York with improved access to the area previously identified as the Northwest Territory, out of which the states of Ohio, Indiana and Illinois had emerged by the time the Erie Canal was completed.

The use of the transportation facilities provided by the Hudson River and the Erie Canal gave an advantage to New York City which was quite disturbing to the rival cities of Baltimore and Philadelphia. By what process could they better their position? The National Road was of some help to Baltimore, but there was need for a better method and from the competitive standpoint, Philadelphia was in third place—a poor third place at that.

Committees representing the commercial interests of both the City of Baltimore and the City of Philadelphia, working independently of each other, began investigations as to what ought to be done. Both groups first embarked upon plans for the construction of canals, but each decided that while a canal might do fairly well during warm weather in the relatively flat country through which the Erie Canal had been constructed, a canal was highly impracticable in the mountainous area lying to the west of Philadelphia and Baltimore.

The people of Baltimore decided to build a railroad and so in 1827 the Baltimore and Ohio Railroad was incorporated. In my opinion, there is ample justification for the claim that the Baltimore and Ohio was the first of the railroads in the United States for the public transport of passengers and goods. Other railroads, including the Pennsylvania, which served the City of Philadelphia, got under way not long thereafter.

The modest beginning of the present New York Central System was inspired by a desire to expedite traffic between the Hudson River and Schenectady, a relatively short distance, but in which the slow movement via the canal had been particularly bothersome. In addition to that, people who originally had been content with canal movement, which was open only during warm weather, soon became dissatisfied when ice closed the canal in cold weather. While New York secured an earlier outlet to the West, it proved inferior to rail service.

Other communities found that the railroads were the answer to their problem and railroad construction, in the light of all circumstances, was relatively rapid. By 1852, the beginning of our Centennial, the railroads were as far west as Illinois and today the rail system of this country totals some 225 thousand miles, which is approximately one-third of the world mileage. So, it is fair to say that here in the United States the nation and the railroads grew together. Territorial expansion, utilization of our vast natural resources, and development of sound and diversified industry were all impossible without the efficient mass transportation system of the railroads.

It is a matter of grave importance to us today and for the future to remember that they grew together because this was a nation of free men dedicated to a belief in free private enterprise as the only economic system under which the full capabilities of men and industry can be realized. This nation could not have attained its present position of preeminence had it not been for a constantly expanding railway system that helped open new frontiers and develop our commerce. Neither could our railway plant have become the greatest in the world had our economic system not offered incentives to efficiency and high productivity. Even in connection with the engineering aspect of railroading we must never forget that transportation service is an economic product, and that here as elsewhere in industry a high level of efficient productivity is the key to success.

The engineering history of railroading down to the present day has been almost wholly a search for methods and means of attaining higher productivity. In one sense, it might be said that the goal of railroad management has been the adaptation of techniques that would put our service on a nation-wide mass production basis.

Looking back over the century, I believe we can see that one of the most important steps in that direction was the standardization of track gauge which made possible the interchange of cars and the operation of through routes. Before that development, rail transportation was somewhat localized and the transfer of freight from one line to another was cumbersome. By standardizing track gauge and equipment the railroads made continuity of movement simple and expeditious and thereby placed a nation-wide transportation system at the service of every shipper. In fact, the free movement of standard gauge cars extends to Canada and Mexico.

Interchangeability of equipment and unrestricted movement over multiple lines are commonplace today, but in any review of rail transportation those innovations must be noted as a major step toward greater and more efficient utilization of the railway system. And we must not lose sight of the fact either that while maintenance of through routes and interchange of equipment are now provided for by law, it was private management acting voluntarily under the incentives of our free enterprise system which conceived and engineered those developments.

Standardization of tracks and equipment seems prosaic when we consider the marvels of engineering in some other industrial fields during the past century, and as a matter of fact, the engineering history of the railroads has not been marked by the spectacular kinds of inventions and discoveries which sometimes amaze us in other fields.

This does not mean that engineering marvels are lacking in the railroad industry. I think that anyone who contemplates the feats that were performed in crossing mountain ranges, in bridging rivers and gorges, in spanning wastelands, most of it before the days of instant communication and complete mechanization, will have deep respect for the courage and ability of railroad's early engineers. But in the field of operations, the record is rather one of constant research and steady improvement, the unending quest for more efficient devices and methods by which to produce more and more units of service at less and less cost.

Perhaps nowhere can this striving for increased productivity be more clearly traced over the years than in connection with motive power. With the opening of the West after the Civil War came increased emphasis upon improvements in

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Operating a Radio Factory in Mexico

By Lee Wilcoxon

Most of us think of Mexico—when we think of it at all—as the land of manana, the land of guitar-playing caballeros and sweet-voiced dancing senoritas, the land of cactus and sand and blistering heat, or as the land of the omnipresent burro. Those who have actually been there think of it as the land of towering, breath-taking mountains, the land with the air-conditioned climate, and as the land where time forgot to pass. Those who have fished the clear, rippling waters of the sun-kissed Pacific along Mexico's western shore will think of it as a fisherman's paradise where all the old, oft-told lies and legends really come true.

But there is another side to Mexico. Mexico—the modern. Mexico—the awakening industrial giant. This side of the country is little known outside of its own borders, yet it is a side that is rapidly arousing the interest of those who have been alert to what is going on below the Rio Grande.

In February, I was asked to go to Mexico and reorganize a radio factory. I was undecided at first. It had been twenty years since I left there, my grasp of the language had slipped and I knew nothing of the factory.

I had visions of a primitive set-up, an adobe-mud building with an earthen floor, and otherwise dirty and unsanitary. I once spent three years helping reorganize the Mexican railroad communication system, and remembered something of the ways things were done at that time. I also thought it might be necessary to redesign the radios and other products, a momumental task.

The company insisted I could finish the job in two or three months, and my family wanted to go. The salary they offered was no particular inducement, but they did include round-trip transportation, all my expenses while there, and "entertainment." I never learned exactly what they meant by "entertainment."

Despite my initial hestitation it really did not take long to make up my mind. I wrote them and accepted their offer.

Our rail trip through Mexico was interesting and entertaining. The train was diesel-powered, the cars were air-conditioned and delightful in every way, and the food was excellent. That trip through the deserts and mountains is a story in itself, one requiring more space than is available here.

We arrived in Mexico on Saturday night. At the railroad station I hired a taxi to take us to the hotel where a suite of rooms had been reserved by the company. That was my first experience with Mexican taxis because there were so few of them when I was there before. That experience was a thriller.

After loading our bags into the trunk of the taxi, the driver got behind the wheel and headed out across the concourse. About half-way across, the engine died. Killing an engine is a commonplace occurrence in the high altitude at Mexico City.

The driver ground away on the starter for a while; then he got out and tinkered with the engine. Then he got back in and used the starter some more. Because he was blocking traffic, one of the traffic officers—traffiic officers are not regular policemen in Mexico—came over to see what was going on. After the driver explained, the officer ordered another car to give the taxi a push.

That driver pushed us right out into the middle of a boulevard, then drove off

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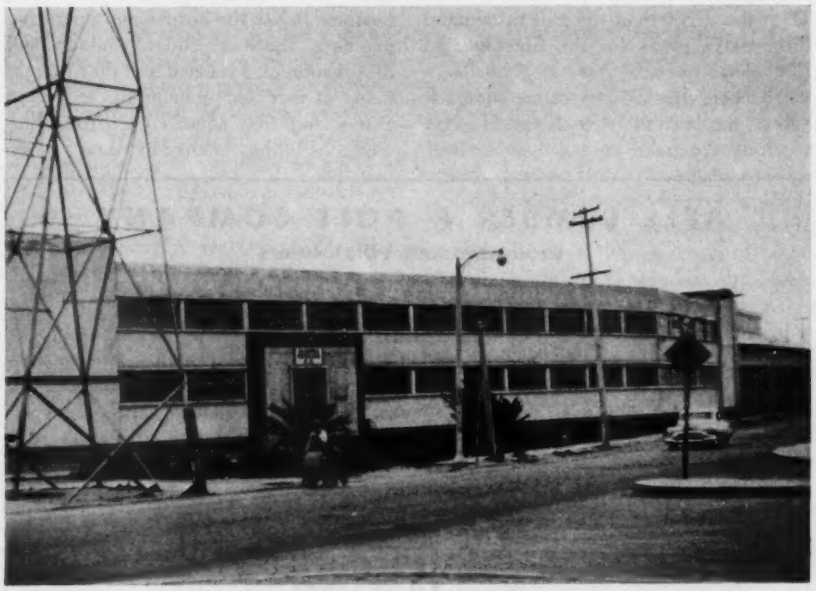

Mexican radio factory, Elektra Mexicana, Mexico City.

Mr. Lee Wilcoxon, a member of WSE, is a Director of the Industrial Training Institute in Chicago, and is an Electrical and Industrial Consultant, his office location being in Des Plaines, Illinois.

(Continued from Page 5)

and left us there. Scores of automobiles were whizzing by on both sides, their headlights threatening us with an eerie menace as they flashed past. My wife was almost petrified with fright, and I was not much better off.

Eventually, another traffic officer came to our rescue. He stopped another autoist and insisted that he give our taxi a push. He did.

"Holy mackerel, was that an experience; one I never want to repeat." How that car managed to push our taxi through such a maze of honking cars, and at constantly accelerating speed, without smashing us up, I'll never know. Surely our guardian angels had their hands full that night.

After several hundred feet the engine of the taxi coughed a couple of times, then settled down to a steady roar. From then on our driver never lifted his foot from the accelerator. We raced around busses, through crowds standing in the streets, around corners on two screeching wheels, and once whipped between two street cars moving in opposite directions so close we almost grazed them both. Several times we missed hitting pedestrians only because their agility carried them from our path. There was no doubt about it, the driver was determined to make up the time lost with the dead engine.

We reached the hotel disheveled and frightened, but each still in one piece. Then the driver had the gall to demand three extra pesos for the time he had lost. That did it!

The president of the radio company called me on the telephone Monday morning to make sure I had arrived. They sent a car to take me to the factory.

The factory was a revelation. The building was two stories high, and of reinforced concrete. All walls were masonary, all floors were masonry with inlaid ceramic tile. The building was modern in every respect, and was both spacious and commodious.

During my first brief inspection trip through the building, I was impressed with many things. The punch presses, the lathes, the coil-winding machines, and all other equipment were as modern as one could find.

The workers were alert and willing, and all seemed to know their jobs. The Chief Engineer showed me the designs and circuit diagrams of the radios and I could easily see that the engineers knew their business. Their designs were equal to those in this country, and I suspected that some of their products excelled our own.

As the production manager took me through the production department, I watched the girls working on the lines. All of them were busy, and the quality of their work appeared satisfactory. I talked with the technicians in the phasing booths where the radios were adjusted and tuned. They, too, were alert, competent, intelligent and appeared to know their work.

I lunched with the procurement manager. We discussed his problems, and I got an insight into some of the differences which exist in operating a business below the border and operating one here. There are both advantages and disadvantages. I learned that they bought many of their components in the United States, but that some come from Holland, including many of their tubes. Their tubes cost about 35% less in Holland than in the United States.

That afternoon I poked into every phase of the operation. I went through the stockroom and got an idea on how they handled their inventory control. I went through the metal working department where they make their own chassis and metal brackets. Then I went to the final assembly department where the chassis and record changers were installed in the cabinets.

Their cabinets are beautiful. Every one is hand-rubbed until it shines. Mahogany and other expensive woods, which are often used in the United States only as a veneer, are used lavishly in cabinet construction. Generally, their cabinets excel ours at every point of comparison. Their craftsmanship is impressive, the craftsmen being satisfied with nothing less than perfection. Because wage rates are low, it is possible to indulge in this passion for perfection. Yet the cost of their finished cabinets is only about one-third the cost of roughly equivalent quality here.

Many of their cabinets are finished with intricate inlaid work and are a joy to behold. They are beautiful beyond all comparison with anything I have seen in the United States.

Most of their cabinets were made by hand in small cabinet shops in Mexico City, but some were made in a new furniture factory in Monterrey. Even on the assembly line in this factory a considerable amount of hand-work goes into the finishing of the cabinets. These cabinets, too, are beautiful.

The following morning I had an appointment with the owner of the factory, the man who had arranged for me to go to Mexico. His office was on the top floor of Mexico City's largest and finest department store. The store was but one of a chain of 18 of which he was the president and principal owner. He also had interests in banks, trucking lines, furniture factories and other businesses.

I was surprised at his perfect English. He spoke without a trace of an accent. I learned that he was a graduate of the University of Pennsylvania, and had married in Ohio. He spent many years in this country, and had surrounded himself with a staff of experts who obtained their training and experience in the United States.

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Visual Aids to Air Navigation

By William H. Floyd

The whole science or art of air navigation is in a constant state of flux. What appeared good enough yesterday is found to be less than satisfactory today, and tomorrow may be wholly inadequate. Even terms are changing. The lighting of airports is no exception to the general rule. Why this is so, at first glance, may not be apparent; but confining our thoughts for the moment to inanimate physical things only, we see airplanes, spots on the earth's surface for them to take off and land, facilities at these airports to keep planes in condition to perform their missions and to permit them to operate, and other features, major and minor. All of these parts are so interdependent that a change in one makes necessary corresponding alterations in each and all of the others, to maintain a proper balance. Since this article is to deal with visual aids to air navigation only, references to aircraft, ground facilities and other phases of the general picture will be incidental. But it is well to keep in mind that all such facilities are closely related and that what affects one affects all.

Today, once a plane has become airborne, modern communication systems go into action to keep it so and on a proper course. The final act in the drama is the let-down and landing at its destination. Under clear daylight conditions this is accepted and accomplished without incident. Only when darkness or obscured visibility intervenes does landing become a problem. Recognizing that other aids do exist, still the final solution to this problem is the provision of light of the right kind, in desired directions, of proper and variable intensity, of standard color sequence, at exact times, and without the creation of an unacceptable flying hazard. Considerations of safety, to personnel, to aircraft and to other property, mark airfield lighting and related visual aids as an essential thing apart, and not just another convenience, or additional necessity or even desirable facility. Failure of building or street lighting is an annoyance for which temporary substitutes can be improvised; but absence of proper airfield lighting during a vital period of time may spell calamity. When it is realized that periods of darkness and of restricted visibility occupy fifty to seventy five per cent of the total time during a year, the vital importance of a reliable lighting aid for air navigation becomes even more apparent.

In an article such as this some limitations must be placed on subject matter. For instance, during periods of reduced visibility, the ideal landing aid combination for incoming aircraft includes some devices to place flying craft in position and attitude to approach a runway for landing, even before the airfield can be seen. Such are the electronic aids, radar and related equipment. After a landing field has been sighted, usually a plane can proceed to land visually. Important as they are, additional aids other than lighting cannot be discussed here. Again, there are certain inherent dissimilarities between military and civil flying procedures. Military designs and operations dare not overlook requirements of combat conditions. Where such divergence exists between operations of the departments, the military viewpoint will prevail. Further, minute details and descriptions of items of equipment can not be given in the space available. Such must be obtained from other sources.

Components

At any airfield, a standard visual aid to air navigation system includes or has included some if not all of these lighting devices:

a. Boundary lighting.
b. Runway floodlighting.
c. Lighted wind direction indicator.
d. Obstruction lighting.
e. Airfield beacon.
f. Runway lighting.
g. Approach lighting.
h. Taxiway lighting.
i. Control system.
j. Service cables.

These will be discussed in the order listed.

Boundary Lighting

An early airfield was simply a fairly flat expanse of suitable size, with some sort of stabilized turf or other surface and no immediate obstructions above or on the ground. The first lighting systems for such fields consisted largely or solely of a string of lights along and around their outer edges. The function of boundary lights was and is to mark the usable landing area of a field. Since the usable landing area of a present day airfield is confined to individually lighted paved runways, other lights marking the boundary of the field have become not only useless but in some instances definitely misleading and hazardous, and their use is being discontinued.

Runway Floodlighting

Landing floodlights, with beams di-

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William H. Floyd, 3rd, a member of WSE, is an Electrical Engineer with the Directorate of Installations AFOAI-CO/s, Headquarters, United States Air Force, Washington, D. C.

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rected ahead of a moving airplane, were used early because nothing better was available. Recent types of runway lights provide better guidance and present little if any navigational hazard. The use of landing floodlights is being restricted to units previously installed in non-hazardous positions; even such use can not readily be justified, and early discontinuance of all such floodlights has been authorized.

Lighted Wind Direction Indicator

The only useful purpose of a free flying or free swinging indicator is the transmittal to a pilot in the air of an indication of the direction of any ground wind, to assist him in completing a safe landing. But when a pilot accustomed to landing at a particular airfield confesses that he has never seen a wind direction indicator the size of a small house and in plain view, the need for such a device can be questioned. However, since he had two way communication with the control tower, from which he received all necessary information and instructions, including direction of landing on a selected runway, such apparent oversight can be more readily understood. A comparatively inexpensive lighted wind cone conspicuously placed readily serves any planes which may lack communications facilities. Dwindling need and mounting cost of a forty foot lighted tetrahedral indicator have made such a device obsolescent and its use is being discontinued.

Obstruction Lighting

Any object, fixed or movable, on or above the surface of the earth, especially at or in the vicinity of an airfield, is a potential flying hazard. Obvious examples are tall trees, elevated smoke stacks and high buildings; but equally dangerous in some locations are low fences, small buildings or other objects of restricted height, even to some degree the devices used to mark and direct attention to obstructions. It is a truism that an obstacle to flying operations which can not be removed, must be marked. On a clear day bizarre combinations of colored flags or painted patterns will serve, but during periods of reduced visibility resort must be made to distinctive lighting. Red is the nearly universal color designating danger, and this color is used to mark obstructive lights on objects above as well as on the ground. In common with all other phases of airfield illumination, obstruction lighting has grown by evolution. The first reaction to an object which might be hit by an airplane coming in to land was "put a red light on it." If followed to its logical conclusion without some sort of planning, this could produce a spectacle little short of ludicrous, red lights all over the place shouting "do not land here." It is obvious that of two structures side by side, a warning on the taller one is sufficient. Equally obvious is the greater hazard of a low object in direct line of flight near the end of a runway, than of a taller object at some distance to one side. These and other ideas are the basis for the development of a standard system for marking and lighting obstructions to aerial navigation.

Airfield Beacon

The positions and arrangement of lighting aids on an airfield assume a more or less standard pattern, with slight variations to meet local conditions. But so do lights along streets and highways, and so also do lights in and on buildings in an industrial area, particularly where such buildings are arranged in long parallel rows or with similar elongated bays on single structures. Sometimes from the air the similarity of such an arrangement of ground lights to the pattern of an illuminated runway is startling, and more than one pilot has mistakenly attempted to land on a phantom landing strip of this sort, at times with fatal results. To provide a device definitely to mark the location of a safe landing area and to produce a readily recognizable homing signal to a pilot not yet in seeing distance of the runway on which he is to land, an airport beacon is used, mounted on or in the immediate vicinity of the airfield, not in the approach and landing pattern so as to avoid creation of an unnecessary flying hazard, and preferably on the highest spot available, to project its beam to the greatest possible distance in all directions. A satisfactory mounting and supporting device is an individual steel tower or a suitable elevated water tank. The beam of light from the beacon must not be obstructed to an appreciable degree in any direction, and must not flash into the operating room of the control tower on the field to cause temporary and periodic impairment of vision of the operators in the control tower. The standard airfield beacon mounted at a field operated by the armed services rotates at six revolutions per minute. Formerly this was a single end beacon, with a special lens producing what appeared to be a double beam, the distinctive mark of a military installation. More recently a second unit has been added to produce a duplex beacon, to emit a plain green beam 180 degrees from the double white beam. This is now standard. Such a beacon is visible from the air on a clear night at distances up to 35 miles.

Runway Lighting

All of the above described components are indeed aids to air navigation, but in themselves do not provide a lighting system capable of guiding an airplane from or to the ground during intervals of limited visibility. The heart of such a system continues to be the lighting devices which depict and outline the usable traffic area or runway. This illumination is the real visual aid to a pilot, either outgoing or incoming.

Early lights used to mark the boundaries of a landing area were simple affairs, little more than a "candle in a milk bottle." But the days of an all over unpaved landing area from which a plane could leave the earth and to which it could safely return during reasonable daylight periods are over for all but the lightest of aircraft and in dry weather. With increase in size, weight and landing speed of aircraft it became necessary to provide a paved landing strip into which wheels could not sink, and to develop some guide to enable a pilot to keep those wheels on a firm foundation at all times, after touch-down and before the plane could be brought to a complete safe stop. Changes in the design and operational characteristics of flying craft have been continuous and rapid. Alterations in design and arrangement of lighting units to serve and keep pace with this rapidly growing infant were mandatory. Experience of those closely connected with airfield lighting indicates that units and systems become obsolescent in three years, and largely obsolete in from five to seven years.

Any lighting unit for delineating the edges of a usable landing strip or runway must incorporate the following features:

a. More light is required on a line roughly parallel with the center line of the runway and at a slight upward

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Building America by Telegraph

By H. P. Corwith

"What Hath God Wrought?"

When Annie Elsworth, daughter of the U.S. Commissioner of Patents, selected the words for the first public telegram on May 24, 1844, she probably had no idea of the far-reaching effect of the phenomenon she was about to witness; yet the phrase was quite appropriate. For this was the initial demonstration of the usefulness of electric energy. The telegraph, crude as it was at that beginning, had brought electricity out of the laboratory for its first practical application, turning the toy of the physicists into a working medium for the benefit of the public and commerce.

The organizers of the American Institute of Electrical Engineers themselves were largely telegraph men. At the organizational meeting in 1884, 21 of the 25 founders were associated with the telegraph industry. Norvin Green, the first president of the Institute, was president of Western Union at the time. Franklin Pope, the second president of the Institute, was also a telegraph man. During the early period, while other electrical industries were in the process of development, telegraph engineers exerted important influence on the activities of the organization. In fact, it is told that as late as 1904, when Andrew Carnegie, an ex-telegrapher himself, gave upwards of a million dollars for the construction of the Engineering Societies Building in New York, he remarked to Secretary Pope—"Well! The telegraph boys will now have a comfortable place to meet." A surprising number of men who distinguished themselves in various fields of endeavor had their first contact with the commercial world as employees of the Telegraph Company. These include such diverse personalities as Roy A. Young of the Federal Reserve Bank, George Bancroft of the movies, John McCutcheon of New Jersey political fame, and Glenn Curtiss, the aviation pioneer. It was only natural that this should be true since, as the first useful assignment of electricity, the telegraph seemed a mysterious, strange, and wonderful medium, highly attractive to adventurous youth.

It was more than twenty years after the inception of the telegraph before the electric illumination field was opened by Brush and Thompson and fulfilled by Edison, or the electric power industry came to flower with the development of Gramme motor-generators. Within these years the telegraph had spanned the continent, stitching together the growing Eastern seaboard cities and the fabulous Western frontier with a thin strand of communication; a strand beset by hostile Indians, toppled by buffalo, sometimes even sabotaged by evil-doers for their own ends, but always back in service again keying and sounding out the commerce of the nation.

And the benefit of the telegraph was not only national, but international. Early in 1854, Cyrus Field, another telegraph pioneer, dared to think of a submarine telegraph cable spanning the Atlantic from Newfoundland to England. Refusing to accept defeat after repeated failures, in 1866 he finally succeeded in laying a practical cable, bringing instant communication with Europe that has since been continuous. His perseverance in the face of adversity and ridicule at last won him the right to be listed with those other immortal pioneers whose faith was boundless.

It is difficult to avoid saying "if it hadn't been for the telegraph—," but we know the phrase probably would not hold true. There were too many minds working on the electrical phenomenon for the art to stay submerged; yet certainly the inception of the telegraph hastened the application of electricity pointing the way to other work-a-day purposes. The operation of the telegraph required long lengths of wire. It had to be insulated, magnets designed and dependable batteries had to be found. Problems of electric circuitry had to be met and solved.

Ezra Cornell, one-time plow salesman, evolved the open-wire circuit with glass "door knob" insulators out of pure necessity when the underground pipe circuit devised by Morse developed faulty insulation while being installed. Edison, whose genius was to touch so much of our home life as well as the needs of the electrical industry, did his early inventing on telegraph instrumentation and was eventually able to set up laboratories, culminating in his Menlo Park "Magic Shop" with $40,000 paid by Western Union for his Universal Ticker. Here is the plaque marking the location of his first power house in New York, on 5th Avenue at 14th Street.

Edison obtained his early telegraph experience with Western Union lines along railroads. Without the railroads, the development of our inland country would have been a tortuously slow process. Without the telegraph the "Iron Horse" would have faced tremendous obstacles. As early as 1851, pioneered by the Erie Railroad, the dispatching of trains by telegraph was undertaken, opening up the single-track lines of that day to much more traffic than could have been handled otherwise. Since the railroads, with their long track-ways, were so in need of rapid communication, and the telegraph was so in need of rights-of-way to set poles, the two joined forces and grew up together all over the country. Both utilities were needed at the same places, the centers of commerce, and so one supplemented the other.

In villages and towns, the sounders clicking in the railway station and the operator in a green eyeshade handling a Morse key were for decades symbolic of Western Union. One occasionally discovers a Morse wire even today, but what a revolutionary change has taken

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H. P. Corwith is the Vice President in charge of Development and Research, The Western Union Telegraph Company, New York. He gave this talk before the Communications Symposium of the Centennial of Engineering in Chicago on September 11, 1952.

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place in telegraph since the days of its inventor!

The essential purpose of the telegraph from the very beginning was to provide quick communication for business, the dissemination of news, and the functioning of government. During the early period of our history, communication traveled at a snail's pace. Couriers could depend only upon the speed of horse-relays and their own endurance to reach far distant points and even in the East the long hauls by train and boat were not fast enough for the increasing needs of commerce and industry. The first short line individual telegraph companies did little to alleviate this condition. Hiram Sibley, founder and first president of Western Union, foresaw that only chaos could be the result of ruinous competition between short lines. He therefore merged many small companies into what was called Western Union, an integrated telegraph company that filled the need for long-distance quick transfer of intelligence at uniform and low rates. Thus orders for goods, news of free-land operations, prices of commodities up or down, as well as reports of salesmen's dealings and whereabouts could for the first time be quickly passed from point to point at uniform rates.

Over the years, transmission methods and service improved as mechanization of operations progressed. By the early 1920's, telegraph operation by the original single wire, ground-return method had reached its peak, the multiplex and simplex printers fulfilling Morse's original dream of printing telegraphy. Increased demand for international communications following World War I had prompted further improvements in ocean cable facilities across the Atlantic. Using hitherto untried but technically sound principles and aided by advances in metallurgy, a continuously loaded submarine cable was designed and laid. It exceeded the best expectations of our engineers in the matter of speed, capacity and dependability. Operating at 400 words a minute the cable was faster "than two women gabbing over the back fence." Vacuum tubes and signal-shaping amplifiers, developed for the new cable, provided increased speed for the older cables as well, some of which dated back almost to the Field original. We had a good system, both landline and cable, and we were making progress.

No business can afford to be static, as the harness-maker and the carriage-builder found out. The products of invention keep up a continuous change so that the situation is like that of Alice in the White Queen's land, where only by running very fast can you even stay in the same place. Western Union found out in the 1930's that we had to run still faster. Other advances in the communication art were catching up. Air mail, heavily subsidized by the government, toll telephone and teletypwriter exchange service were offering ever-increasing competition.

During the busy World War II years we made plans and, when men and materials became available, the new look planned in the Western Union system began to take shape. We had in mind a system where only two operators would be needed, one to send and one to receive the telegram, instead of the old system in which messages were handled between distant points with intervening manual relays, with as many as five people han-

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Any member of the Society may compete regardless of grade of membership.

Papers shall not be highly technical in nature. A clear, concise and interesting coverage is desired rather than complex formulae or derivations. The subject discussed should be of general interest to engineers but should not be of a political or highly controversial nature.

All members of the Society who wish to submit papers in this contest should contact the Secretary as early as possible and not later than February 1, 1953, and request a copy of the rules governing the competition and an outline of the minimum requirements for acceptance of papers. These cover in detail the mechanical make-up which should be followed in preparing and submitting papers for the contest.

Papers must be submitted to the Secretary for acceptance by April 1, 1953. If the Secretary finds that they meet the minimum requirements of the contest, he will forward them to the Awards Committee for review. The papers will be identified by number only. The Secretary of the Society is the only person who will maintain the key to the authors.

If any paper does not comply with such minimum requirements, the Secretary will so advise the author and discuss with him the points which are below the minimum requirements. The papers which are accepted will be forwarded to the Awards Committee for judging not later than May 1, 1953. Papers which have not met the minimum requirements by that time cannot be considered for prizes.

Papers which are accepted will be judged on originality of presentation, editorial merit and value to the engineering profession.

The papers submitted must not have been previously published in substantially the same form. No copyrighted materials shall be used unless permission has been obtained and so indicated. All manuscripts, drawings, etc., are to become the property of the Society and cannot be published without the consent of the Society.

If the papers submitted are NOT of sufficient merit to warrant the award of any or all of the prizes, the Awards Committee reserves the right to award less than the five established prizes or to postpone the competition.

The winners will be announced and the prizes presented at the annual meeting of the Society in June, 1953.

WSE Executive Secretary will furnish you with a complete set of rules and minimum requirements on request.

Role of Railroads

(Continued from Page 4)

the steam locomotive, which at that time was capable of producing considerably less on the average than 20,000 pounds of tractive effort per unit. By 1893 freight locomotives had been developed with a tractive effort in excess of 35,000 pounds, and by 1905 the Santa Fe type compound locomotive was able to develop over 62,000 pounds of tractive effort.

These progressive increases in power were accomplished principally by improvements in boiler efficiency and the advantages of higher pressures. But the resulting product was still merely a better steam engine. The effort continued to find still more efficient sources of power, and the turn of the century saw the development of electric locomotives which gradually increased in rather limited use until a maximum ownership of about 870 units was reached in 1943. Finally, in the thirties, the efficiencies of the diesel engine were applied to rail motive power; and if any development in the art of railroading in the past century may be called revolutionary, the advent of the diesel deserves that description.

A diesel-electric locomotive was first used to propel a streamlined train in 1934. The first diesel-electric freight locomotive was placed in service in 1940. Although the diesel switching locomotive was introduced somewhat earlier, its development had not advanced to the point where it began to come into general use until about the middle of the 1930's.

During this relatively short period of time, the diesel locomotive has become the dominant source of motive power for the railroad industry. In May of this year, 66% of the road freight business and 68% of the road passenger business on all Class I railroads in the United States were handled by diesel locomotives. Diesel power performed 76% of their yard work.

With the advent of the diesel-electric, less attention was focused upon the straight electric locomotive, and recent years have seen little expansion of electrification systems. Some 2% of the road freight business, 6% of the road passenger business, and 1% of yard work of the Class I railroads is now handled by electric locomotives.

The diesel-electric, when used in combination of four units to make up a powerful locomotive in keeping with common practice in heavy over-the-road service, will out-perform the best of the steam engines. It was very largely the diesel which enabled the railroads, in 1950, to increase by 50% the output of tons per train and to double the output of tons per train hour as compared with the year 1929—the year 1929 was the last year of high level in the economy prior to the tragic depression of the thirties.

In an entirely different field of engineering and railroading the search for efficiency and improved productivity led to changes that were nearly as important as the development of motive power, if somewhat less dramatic. As we speed along by rail, in this age of almost complete mechanization, through deep cuts and over long high fills, it is hard to comprehend the fact that when our railways first pushed west across the Alleghenies and later across the Continental Divide we were using earth-moving methods almost as old as recorded history.

It is no figure of speech to say that those early road-beds were hand made, for our tools were picks, shovels and wheelbarrows, and the most modern labor-saving device during many of the years of great railway expansion was the horse-drawn dump cart. It would make a fascinating story in itself to trace the development of earth moving machinery and track maintenance devices down to this day of giant diesel powered bulldozers, scrapers and drag lines, of multiple tampers and mechanical ballast cleaners. It would be a story of a great contribution by engineers and manufacturers to the development of our transportation system.

We could go on almost endlessly in recounting engineering advancements of this kind during the past century. The old method of applying car brakes by hand, for example, was inefficient and unsafe, and it seriously limited the length and speed of trains.

The air brake, first developed in 1867 and now greatly improved, solved this problem and made a great contribution to safety, efficiency and economy.

With the electric locomotive, regenerating braking was helpful on descending grades in mountainous territory. This regenerating braking is accomplished by utilizing the traction motors as electric generators while descending grades. The electric current so generated is turned back into the power transmission lines.

It was recognized early in the use of the diesel in freight service that a brake similar in principle to the electric regenerative brake would be desirable. The first such brake was applied to Santa Fe freight diesel locomotive number 100 in January, 1942. This has been named the dynamic brake and with the diesel locomotive, which does not require the use of a power transmission line, the energy coming from the traction motors used as generators is dissipated through air-cooled grids. This brake has proved to be of substantial assistance on descending grades because it will retard the movement of a train to a degree which greatly reduces the use of the customary air brake. It is primarily a retarding or holding brake, however, as distinguished from a stopping brake. Its use as a holding brake has eliminated much of the damage to wheels and brake shoes due to over-heating, which overheating was

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a plague in freight train operation in mountainous territory.

The automatic signaling system made possible by electric energy has provided scores of devices and techniques for improved safety, high speeds and greater utilization of tracks. One of the latest developments in signaling is centralized traffic control, which, by taking advantage of advancements in electronics, permits safe operation of trains under a system where train movements are authorized entirely by signal indication.

The greater efficiency of the centralized traffic control system enables a single line of railroad virtually to do the work of a double track. The contribution to higher productivity, and lower cost is manifest.

When we turn to freight and passenger equipment we find the same evidence of private management's constant striving for the rewards of enterprise and efficiency. The results are significant in two aspects. From the standpoint of engineering design, freight cars have steadily increased in carrying capacity, in availability for service, and in durability. In the field of passenger equipment, the twin developments of light weight streamlining and air conditioning were perhaps the chief engineering and service advances.

The other aspect of engineering progress in the field of equipment relates to diversification and the adaptation of rail facilities to the needs of commerce. Nowhere are the results of that progress more striking than in the fresh fruits and vegetable industries.

In New York and cities similarly situated, it is commonplace to buy oranges, grapes and apples from such distant states as Florida, California and Washington. Fresh meat and other perishable food products are available every place. Without the mass transportation service of a vast refrigerator car fleet it would be impossible. Moreover, the tremendous and far flung agricultural industry that lies behind this segment of our commerce could never have come into existence without the marketing outlets afforded by this specialized form of transportation.

Today, at this Centennial milestone, we have a railway system totaling about 225 thousand miles of line over which moves about 60% of the nation's domestic freight commerce. Viewed in relation to other agencies of transportation, the three outstanding characteristics of this rail system are its extensive coverage of the country, its ability to handle anything movable at any time for any destination, and its almost unlimited reserve capacity.

The unique ability of railroads to expand as volume carriers and as instruments of mass transportation was strikingly demonstrated during the second World War. The increase in railroad passenger traffic from 1940 to 1944 was greater than the total growth in that traffic during the entire 110 years of American railroad history from 1830 to 1940. The increase in railroad freight traffic from 1940 to 1944 was greater than the total growth in that traffic during the first 85 years of railroad service, or from 1830 to 1915.

Expressed in percentage relation to other agencies of transportation, the railroads moved a little over 62% of commercial intercity freight traffic in the pre-war year of 1940, while in the peak war years of 1943 and 1944 they handled over 72% of all freight and over 90% of the war traffic. It staggers the imagination to consider that this amounted to approximately a billion and a half tons of freight a year, or 50% more than the railroads had hauled in pre-war years.

That accomplishment reflected most of the fundamental characteristics of the rail method of transportation as it has been developed under private management in this country. All other forms of transport are limited in the territory served, or in the seasons and weathers in which they can operate, or in the nature of what they can haul, or in their ability to expand capacity readily and economically. No one of them, nor all of them together, could take the place of the railroads as the true common carrier of the nation's commerce.

The engineering developments and advances which we have only briefly noted are yielding measurable returns today. By any standard of operating efficiency, the railroads are a vital and progressive industry. During the period from 1921 to 1951 the average freight train load increased 100% and these larger loads were hauled farther and faster per day and per hour. In that same period, freight car miles per serviceable car day increased from 26 in 1921 to 45 in 1951.

When comparative transportation service is expressed in terms of net ton-miles per freight train hour—a revealing measure of performance—we find an increase from 7500 in 1921 to nearly 22,000 in 1951. In other words, in comparison with 1921, the 1951 movement of a freight car increased by three-fourths. The average freight train handled double the amount of freight at almost half again as much speed, and consequently the net ton-miles per freight train hour, which reflects the combined effect of both increased load and greater speed, were nearly 3 times as great.

These improvements in efficiency are not so apparent on the surface as are the changes in some other fields of transportation. To the off-hand glance, a railroad today looks much the same as the railroad of 1900. But improvements in motive power, particularly dieselization, and almost complete mechanization in construction and maintenance departments, have wrought a revolutionary change in operations, largely in the past generation. And the improved efficiency

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Crerar Library Notes and News

Dr. John T. Rettaliata, president of Illinois Institute of Technology and Armour Research Foundation, was elected to the Board of Directors of Crerar at the October meeting of the Board. Dr. Rettaliata fills the vacancy left by the resignation of Dr. Henry T. Heald.

The closely allied interests of the Crerar Library and of I.I.T. and Armour Research Foundation make Dr. Rettaliata's new appointment important for all three of these leading technical institutions. Crerar Library is used extensively by students and research staff, from Technology Center, and the Library's Research Information Service does library research for many of the same companies which have laboratory research projects at Armour Research Foundation.

Dr. Rettaliata's election adds to the long line of distinguished industrialists and professional men who have guided the development of The John Crerar Library during the past fifty-eight years. Several of these, including Dr. Rettaliata, have been drawn from the field of engineering. Those still on the Board are William V. Kahler, president, Illinois Bell Telephone Company and former president of WSE; and Eugene W. Kettering, director of engineering, Electro-Motive Division, General Motors Corporation.

Other men, distinguished in engineering and related fields, who served as Crerar directors, were Dr. Henry T. Heald, now president, New York University; Dr. Arthur H. Compton, chancellor, Washington University in St. Louis; and the late Col. John A. Holabird, architect and engineer, who was principally responsible for the design and construction of the Crerar Library building. Other Board members who were active in early railroad engineering in the Midwest, especially Timothy B. Blackstone, were referred to in this column in December, 1951.

A Financial Opportunity ...for the Operator

The oldest con game in the world, it seems, is still being played. One of our members just received the letter published below. The letter he received, we understand, is but one of nearly a thousand sent out daily.

We also understand that the operators stay within the realm of the law, or at least of postal regulations, by making sure that no money is sent through the mails.

This would be but an amusing incident except that a list of our members may have fallen into improper hands. To warn all members that this is strictly a confidence game, we print the letter herewith.

Mexico, D. F., November 10, 1952

Dear Engr. . . .

A person who knows you and who has spoken very highly about you, has made me trust you a very delicate matter of which depends the entire future of my dear daughter, as well as my very existence. I am in prison sentenced for bankruptcy, and I wish to know if you are willing to help me to save the sum of $450,000.00 U.S.Cy., which I have in bank bills hidden in a secret compartment of a trunk that is now deposited in a Customhouse in the United States.

As soon as I send you undeniable evidence, it is necessary that you come here and pay the expenses incurred in connection with my process, so the embargo on my suitcases can be lifted, one of which suitcases contains a baggage check that was given to me at the time of checking my trunk for North America, and which trunk contains the sum above said. To compensate you for all your troubles, I will give you the THIRD PART OF SAID SUM. Due to serious reasons which you will know later, please reply via AIR MAIL. I beg you to treat this matter with the utmost reserve and discretion. Fearing that this letter might have gone astray and not reached your hands, I will not sign my name until I hear from you, and then I will entrust you with all my secret. For the time being I am only signing "F."

Due to the fact that I am in charge of the prison School, I can write you like this and entirely at liberty. I can not receive your reply directly in this prison, so in case you accept my proposition, please AIR MAIL your letter to a person of my entire trust who will deliver it to me safely and rapidly. This is his name and address:

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The reward of each member selling WSE is a command of presentation. That command lifts the engineer high in the leadership of his industry.

Stand behind us. The Society is ready for a two-fold increase. We can get that increase if each one of us secures a member.

HENRY COFFMAN, Chairman

LEE BIRD, Assistant Chairman

Membership Committee

Role of Railroads

(Continued from Page 13)

revealed by the performance statistics just cited has inured to the benefit of the public in two ways.

First, it has brought better rail service at lower cost. The average revenue per ton-mile received by the railroads is a direct reflection of what shippers pay for rail service. In 1950 the railroads received an average revenue per ton-mile of 1.329 cents as compared with 1.275 cents in 1921. This was an increase of slightly over 4% in actual dollars. But if we equate the results to a dollar of constant value, we find that there was a decrease of 37% in net ton-mile revenue over the 30-year period. This means that shippers are today receiving considerably better rail service at substantially less real cost.

In the second place, improved efficiency and higher productivity have enabled the railroads to survive the subsidized competition which they have been forced to meet in the past quarter century. Rail expenses per ton mile amounted to 1.078 cents in 1921 and 9.05 mills in 1950, or a reduction of 16%. In terms of constant-value dollars, the record is even much better. Thus railroad management not only preserved the position of the railroads as the lowest-cost form of transportation, but also enabled the railroad industry to withstand constantly increasing wage and material costs and taxes, and the diversion of traffic to competitive agencies which enjoy the benefits of extensive promotional programs and direct aid from federal, state and local governments.

The full impact of governmental policies in fostering competitive transportation agencies would have fallen even more heavily than it has upon the public had it not been for the high level of traffic which our economy has produced in the past two decades and for the steady drive toward lower rail cost. While the railroads' share of the nation's traffic has declined relatively, the absolute volume has continued to grow with our expanding economy. The problem here does not lie in any deterioration or obsolescence in the railroad plant. There is still a vital need for the sort of mass transportation service which only the railroads can give. The problem lies at the doorstep of governmental subsidy, which we think has extended far beyond the limits of fairness and economic justification. I think, however, that we already see signs that the people are growing tired of footing the bills implicit in subsidized transportation and I confidently look for a change in governmental policy in this area.

Here is another way to indicate the rapid improvement in railroad efficiency brought about by the constant investment in new facilities and the development and adoption of new operating methods. It is indeed a record of which the industry can be proud at the close of this hundred years. It shows that age has not slowed the railroads' pace in improved service. In the ten-year period between 1939 and 1949, the productivity of the railroads increased over 30%, or at an average rate of 3% per year. The manufacturing industry of the United States is universally regarded as having made outstanding technological progress in recent years, and certainly, in relation, some segments of the manufacturing industry are in a youthful vigor. Yet in the period 1939-1949, the increase in the rate of manufacturing productivity was only one-half that of the railroads. We may thus leave our brief appraisal of current performance with the observation that the railroad industry is continuing to grow with the nation.

As we turn now to a look at the future, I want to reemphasize an observation I made at the outset. Our nation and our industries, including the railroads, reached their present position because they came into being and were able to develop under a free private enterprise economic system.

The keystone of that system is the product, whether it be goods or services, of a continuously improved quality at the lowest possible cost. The health of the system depends upon the level of productivity which business is able to attain. Whatever reduces productivity weakens the economic structure. That is true whether it be technical problems which engineering might solve, whether it be management's ineptitude or labor's inefficiency, or whether it be ill-considered governmental policies that deaden initiative and incentive. We must stimulate rather than discourage initiative and incentive. Competition under a free economic system is a great stimulant. It has been said that while competition may be the restless pillow of management, it is the motive power of progress.

No matter how great or how small the engineering problems of tomorrow may be, we shall attain the highest level of productivity only if we have the spur of a free competitive market to drive us on. The vital spark of imagination, the indispensable will to achieve, have not survived elsewhere and would not here survive the deadening influence of state ownership, nor can they yield their best results under the stifling influence of unfair and burdensome regulation.

But if we may look forward to a healthy climate for continued improvement, I think the United States can be assured of rail transportation which will remain unequaled in the world. We have learned during the past century of engineering that what the future holds in the way of technological advancement is not forseeable or predictable. It is quite amusing today to read that in 1830 there were men who worried about the displacement of horses and their drivers by the steam engine which burned coal, and there were men who worried about the grave situation with which America would be confronted when the last pound of coal had been placed in the firebox.

Who knows what tomorrow may produce in the field of motive power? Who knows the full potential of our newest source of power, i.e., atomic energy? It may ultimately open to us sources of power so vast as to be incredible by today's standards. In the field of equipment, I think we have only scratched the surface so far as reduction of friction and dead weight are concerned. Today the cost of metals which reduce dead weight imposes a limitation on their wider use, but I believe the day will come when we shall see light weight streamlined freight trains as commonly as we now see their counterparts in the passenger field.

Tomorrow will bring a lot of improvements, and I envy the men who will appear upon the platform at the second Centennial of Civil Engineering. I am sure our accomplishments will seem puny when compared with theirs. I hope they will think of us charitably.

I am very thankful that I have lived in that part of the twentieth century which has terminated the first Centennial. It's been a lot of fun.

●

Mexican Factory

(Continued on Page 6)

He told me that he had acquired the radio factory as a bankrupt business a year earlier, then moved it to its present location. After acquiring the factory, he made a trip to the United States to inspect similar factories here, including Hallicrafters, Motorola and Wells-Gardner in Chicago. Through friends of mine at Hallicrafters, he learned of and got in touch with me.

My employer wanted his factory to operate along the same general lines as those he had seen in Chicago. He wanted efficiently designed production lines, properly located stock rooms, and a revamped metal working department. That department, where they make their chassis and brackets, had always been a bottleneck. He wanted the entire factory laid out so that it could begin the manufacture of television sets whenever desirable, for Mexico City has three television stations, and others are being built, and there are other stations in other parts of Mexico.

Because the metal-working department was holding up production in other departments, I first directed my attention there. The tools were good, but the best use was not being made of them. In punching the chassis they used a separate stroke to punch each hole, even though it was only for a 6-32 screw. They spent more time setting up their machines than they did in working. Even worse, they would run only 150 to 200 chassis before switching to another model. It didn't take long to see why that department was a bottleneck.

They had four presses, including one 18-ton double-action press. I asked the foreman why they didn't punch more holes with each stroke of the press. He insisted their lathes were too small to make the necessary plates for the dies.

I was not satisfied with the answer, so asked one of the die-makers if he could make a larger die and plate. He said it would be easy to do. I told him to go ahead and make it. In only nine days he made a complete set of dies so that the largest chassis could be punched in four strokes instead of the 90-some formerly needed.

The next action was to increase the number of chassis made on each run. On the first run with the new dies, 500 chassis were turned out. By that time a new set of dies were ready for another model. We ran 750 chassis of that model and 1150 on the next. Then we settled down to making 2150 chassis on each run. Soon the metal working department was turning out chassis faster than the other departments could use them.

Labor is cheap in Mexico, so cheap that it is wasted—badly wasted. Sometimes this waste of labor slows down production. I saw this happen several times.

This factory makes all of their own tuning coils. The coils are fastened to the chassis with a small bracket which is also made in the factory. Formerly, one man would cut strips of steel into short lengths, another would drill holes in each end, a third would make two bends in the metal, and finally a fourth would use a ballpeen hammer and a special forming tool to make a slight curvature in one end to fit the coil. Four or five men worked constantly—every day—doing nothing but making those little brackets, none of which weighed more than an ounce. Worst of all, they still could not keep up with the needs of the coil winding department.

The remedy was simple—use a single forming-and-punching die. One of the die-makers said he could make the die, and he did. With the die one man could punch more brackets in a couple of hours that the entire group had formerly been making in an entire day.

That die-maker was a craftsman. I did not have to tell him how to make the die, merely what kind I wanted. He went right ahead and made the die without further instructions.

There were many other similar incidents of that nature. The men knew their work, and could make almost anything. All they needed was somebody to tell them what was needed: they did the rest.

The Mexican factory used more grill cloth than is generally used in this country. Such usage necessitated punching holes in the cloth for the control shafts and for the dial. Formerly, these openings were cut with a wood chisel, then smoothed with a rat-tail rasp. It would take a man six or seven minutes to prepare each panel.

My solution may not have been the orthodox one, but it was effective. The machine shop prepared a small punch to cut out the round holes in the cloth. A special sliding cutter was made to cut the holes for the dials. With these little aids a man could prepare a panel in less than thirty seconds, and do it more easily.

My amazement never ceased at the readiness with which the workers accepted new and different procedures. Seldom would anyone insist that something could not be done. For the most part, all that was needed was mere suggestion: they took over from there and made their own improvement.

Equally effective changes were made on the production lines, and the results were occasionally even more spectacular. No one had ever attempted a time study before. Some line workers were completing their operations in two minutes while others required fifteen or sixteen minutes to complete theirs. The results were so self-evident as to make it seem that anyone could see them, but apparently no one ever had.

As often happens in a case like this, those workers who were previously lightly loaded resent the addition of work. But here, none of the girls appeared to mind the extra work at all. They kept right on singing and smiling. None ever

(Continued on Page 18)

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failed to have a big smile for me. No group could have been more friendly. I do not think that anyone in the factory ever felt the slightest trace of antagonism toward me for any change I made. Certainly there was no evidence of it.

Several humorous incidents arose during the course of designing the new chassis production lines. The work benches of the old lines were so high that the girls had to stand on boxes or sit on very high stools. Either way was uncomfortable. The benches were slightly more than a meter in height.

It was specified that the new benches should be not more than 75 centimeters in height, a comfortable height which allowed the girls to sit on chairs and keep their feet on the floor. When the line foreman, the production manager, and others were checking over the drawings, a minor disagreement developed as to whether the benches were too low. The line foreman insisted that the girls could not get their knees under them.

I told them I thought they could and said facetiously that the best way to find out would be to measure the girl's legs and make sure.

A few minutes later I glanced through the glass windows of the office and saw all the girls from one of the production lines standing in a row. The line foreman had a steel tape and was gravely measuring the girls' legs.

One morning when I had but a few days' work left before I finished my job, the owner visited the factory. He was dissatisfied with a number of the business activities. The stock inventory was entirely out of line with production schedules, the collection department had over a million pesos of old accounts on the books and was doing nothing to collect on them, and the sales department was making credit sales to accounts badly behind in payments.

The management had been warned several times about these items. This morning the owner had blood in his eye. He fired virtually the entire management group including the president, general manager, procurement manager, and others.

A few hours later he called me to his office and asked me to take charge temporarily until he could get a permanent manager. I told him I was planning to return to the United States the following week, and had other plans already made. But after further discussion I agreed to take charge for two or three weeks. But I insisted that I could remain no longer than that.

That was a ticklish position for me. All the department heads were gone and I had to find replacements. In Mexico there is no general labor pool of skilled personnel on which one can draw in a situation of that kind.

The immediate problems were solved by promoting men from the ranks to take over supervisory jobs. They proved to be unexpectedly competent. They did a wonderful job! Production immediately surged upward; there was more energetic activity in the collection department, and money started coming in on old accounts; and sales began climbing.

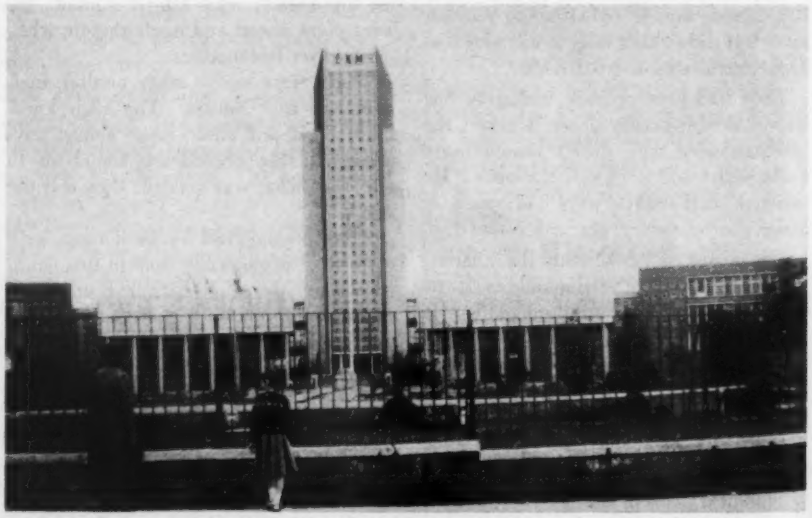
The owner had two men in mind for the manager's job, but he was unable to get either of them. This forced me to remain longer than I had agreed to do. Upon my urgent recommendation, he finally and reluctantly agreed to give his oldest son a try at the job. His son and I had become quite friendly and I had more confidence in him than his father had. He quickly caught on to the details of the operation.

To me, the greatest satisfaction in the whole experience was the record written by my group of amateur managers during the final month that I was in charge. Production figures, collections, and sales during that month were almost exactly four times the totals during the last month under the old management. I will be eternally grateful to those workers for the way they rallied around me and helped clear up a most difficult situation. Without their help, most of my efforts would have failed.

Industry in Mexico is expanding at an unbelievable rate, especially in the larger cities of Mexico City, Puebla, Monterrey, Vera Cruz and Guadaljara. Many large companies from the United States are building assembly plants there. General Motors has an assembly plant in Mexico City so large that it requires a solid trainload of parts every day. Ford has a plant nearly as large, and is now building a huge tractor factory, the first in the country. Nash, Hudson, Chrysler and other automobile companies from the United States also have assembly plants there.

Both Goodrich and the General Tire company have large tire factories in Mexico. Probably other rubber companies also have plants but I did not see them. General Electric company has a large assembly plant about ten miles north of Mexico City where they build refrigerators, radios, television receivers, motors, and many other items including fluorescent lamps. Westinghouse has an even larger plant across the mountain to the west of the General Electric company plant.

New housing in the form of both houses and apartment buildings is being erected at an unprecedented rate in and around Mexico City. There is also a great amount of building in other parts



Administration building and some classroom buildings at the Polytechnical Institute, Mexico City.

of the Republic. Yet there is still a serious shortage.

At the south edge of Mexico City, on the road to Cuernavaca, there is rising what is claimed to be the largest university in the world. It is the new home of the University of Mexico. The University of Mexico is by far the oldest university on the American continent, being about a hundred years older than Harvard. But during its entire existence it has been housed in widely scatered buildings, some miles apart.

Soon after President Aleman took office in 1946, he ordered work started on a new home for the university. Aleman is the first president to be graduated from the university, and is the first who was not formerly a military man. There has been some criticism of his administration, but there can be no denying that he has started Mexico on the pathway towards becoming an industrial nation.

Mexico is still critically short of technically-trained workers. Mexicans have a great natural talent for mechanics and other technical trades, but they have never had facilities for learning the trades. The new Polytechnical Institute is making great strides toward correcting that situation. Already the Institute has many buildings in use for teaching purposes, at least one of which is more than fifteen stories high. More than forty acres of new buildings are now under construction.

There can be little doubt that a great industrial future lies ahead for Mexico, unless something radical happens to arrest the trend. Mexico has nearly Everything: natural resources, a plentiful supply of labor, a wonderful climate. Now Mexico is getting those things it has previously lacked—technical know-how, friendly governmental treatment, and plenty of capital.

Much of the capital flowing into Mexico comes from the United States, but some is also coming from Canada and other countries. The Mexico City power company is owned by Canadians, as is the street railway system.

The present tax situation in Mexico is an investor's dream. Tax-harassed investors from this country find it hard to believe that such a condition can exist. Taxes are so light as to make Mexico seem a financial heaven in comparison with this country.

Aids to Navigation

(Continued from Page 8)

angle from its surface, than in any other direction. To produce such a beam or beams, the lens of any runway marker light must be asymmetrical, designed to throw a concentrated shaft of light in two directions nearly 180 degrees apart, and to emit incidental light to each side and up. The intensity of the directed beams is dependent upon the service which a particular runway is to sustain, and is controlled largely by the size of lamp used, by its position, and by the five brightness taps on the control regulator in the control tower.

b. The horizontal dimension of a lighting unit is of little consequence, but its height above ground poses two diametrically opposed problems. The fixture must be high enough to provide the illumination desired, above permanent or recurring obstructions such as uncut grass and weeds or drifting snow or sand; but it must not be so tall that it presents a hazard to the wheels, wings or other parts of passing aircraft. Then too, a standard lighting unit for service under arctic, temperate or tropical conditions does present other problems.

c. Out of the welter of interlocking and conflicting demands posed by design and operating types and conditions of runways and airplanes, by weather and by economic limitations has come a succession of types of runway light, basically fixed but in details continually changing to meet constantly growing and varying demand; and the end is not yet in sight.

Runway Lighting—Types

Early types of runway marker lights were semi-flush about twelve inches in diameter, and from 2¾ inches to 6 inches above ground, mounted on a hollow cast iron base buried in the earth or set in concrete. Later types were designed to withstand without damage a weight of 100,000 pounds. The latest type, approximately 3 inches above ground level, is still standard but mostly for replacement purposes.

Another type which was designed for use at air bases subject to deep snow and called the "snow light," is no longer standard and has been replaced by a later design.

The current "medium intensity" light for use on runways of secondary importance and on taxiways is cone mounted, and is approximately 14½ above ground level, and has a beam of not to exceed 3,000 candle power.

Today standard practice requires for use on the "instrument" or principal runway of main bases, a "high intensity" light which provides a beam in excess of 6,000 candle power, and stands approximately 12 inches above ground level. These lighting units are used in conjunction with high intensity lights installed along the sides and on the threshold of the approach area to an instrument runway, which are cited in the following section.

Approach Lighting

In approaching the end of a runway for landing, it is necessary for a pilot to assume a proper attitude, both horizontally and vertically, before his airplane reaches the end of the runway

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selected. In clear weather the runway lights may provide the necessary guidance. During periods of reduced visibility due to fog or other conditions, additional guidance beyond and leading to the end of the runway is required. To provide such preliminary guidance is the function of approach lights. To avoid a premature landing in the unpaved approach area, lateral approach lights are aviation red.

Approach Lighting—Types

In common with other lighting units in an airfield lighting system, approach lighting units have evolved by trial and error. Early types were too tall and presented an unacceptable flying hazard, particularly in the first 1,000 feet beyond the end of a runway.

The current standard approach lighting unit stands approximately 14½ inches above ground level. Lateral units emit aviation red light and threshold units emit aviation green light, predominantly in two directions roughly parallel with the center line of the runway extended, and each uses an electric lamp rated at 13,000 lumens, in contrast to runway high intensity lights using a lamp rated at 5,700 lumens. In evaluating these comparative brightness intensities, it must be remembered that a colored lens absorbs more light than a clear (white) lens.

Taxiway Lighting

Taxiways provide an off-runway paved path between runways and parking areas. For guidance of airplanes moving on the ground during periods of reduced visibility, taxiways are marked by typical lights to distinguish them from adjacent or intersecting runways. The lighting fixture used is the fixture commonly employed for medium intensity runway lighting, but to provide ready recognition as a taxiway, blue filters are placed over the lenses.

Control System

The principal point of control for an airfield lighting system is located in the control tower. By manipulation of switches on a control panel the attendant operates control equipment in a remote vault or building, which in turn energizes a light or series of lights on the flying field. Standard practice requires the placement of an emergency control point located preferably in the vault, but in any event at a distance from the control tower, to avoid destruction of both points by one stroke of an enemy or otherwise.

Color Schedule Prescribed for U. S. Air Force Bases

a. Runway Lateral Lights.....Aviation Clear (White)
b. Runway Threshold Lights.....Aviation Green
c. Taxiway Lights .....Aviation Blue
d. Approach Lateral Lights.....Aviation Red
e. Approach Threshold Lights.....Aviation Green
f. Obstruction Lights .....Aviation Red
g. Airfield Beacon Light.....Alternate Aviation White and Green Flashes
h. Hazard Beacon Light.....Aviation Red Flashes
i. Wind Direction Indicator (Wind Cone) Lights.....Aviation Clear (White)

The use of yellow filters for some runway lights has been discontinued.

FIGURE 1.

Service Cables

To avoid an increase in hazards to air navigation, no overhead electrical conductors can be installed on or in the immediate vicinity of a flying field; all circuits must be placed underground, in ducts or directly in earth. The number and size of electric cables necessary to carry in central depot stocks has been reduced to a minimum. One conductor No. 8 A.W.G. 5,000 volts cable is standard for most lighting circuits. Recently a series of standard length fitted cables has been adopted for use between adjacent runway and taxiway lights, to facilitate transportation and installation at all air bases, but particularly at bases in a theater of operations. These cables come in cut lengths of 3′, 10′, 20′, 50′, 103′ and 205′, each length having on its ends one rubber covered plug and one rubber covered receptable, which when properly joined to companion terminals on other lengths form water-tight connections. Individual rubber covered series—series transformers for direct burial near each light and with terminals fitted with similar plugs and receptacles—complete the picture.

Specifications

For military purposes all airfield lighting equipment for use at Air Force bases, world wide, is manufactured in accordance with military specifications basically for combat theater use; the design is such that the various items will be readily airborne, and may be used in fixed base installations by the addition of simple accessories, by the method of installation and by a variation in the source of electrical energy.

Limitations

Vital as it may be, any lighting system or device for use on or near a field is subject to definite limitations. Transmittal of light to distance is not necessarily in direct proportion to the intensity of the source. Under normal conditions a lamp rated at 500 candle power may be sufficient to transmit a light of suitable intensity to a given distance. Under adverse weather conditions, with one half mile visibility, 50,000 candle power may be required to transmit light of comparable intensity the same distance. Under such conditions, other methods of communication such as electronic devices can play a large part, particularly in the early stages of an approach to a landing area.

Color Code

Color plays an important part in an airfield lighting system. At any U. S. Air Force Base, worldwide, the color schedule shown in Figure 1 is prescribed.

Standardization

During World War II an effort was made to standardize civil and military products and procedures in matters dealing with airfield lighting design, procurement, installation, operation and maintenance. One result was a series of ANC (Air Force-Navy-Civil) standards,

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formulated under the authority of the Aeronautical Board, with use by all agencies made mandatory. Many of these standards are still used by the armed forces and the civil authorities, and indeed some of them have been and are being adopted as standard by the corresponding international organization, of which the United States is a member.

This is a technical discussion only. No account has been taken of economic conditions, but mention can be made of the fact that providing for the safe landing in murky weather of one air liner or bomber can justify the expenditure required for a good airfield lighting system. One such airplane may have a value of many lighting systems, and who will venture to place a cash value on human life?

Routine and emergency, but safe, landings and departures under all weather conditions form a story both vivid and real, in which light performs a major part. It is now apparent that on a modern air base the old saying is still true, and that "The men who keep 'em burning are the men who keep 'em flying—at night."

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dling the message at each relay point. With our new system, all of the routing and relaying could be handled by electronics or by high speed switching machinery.

Today we are very close to that objective. Our 15 modern high speed message centers at strategic locations about the United States receive originating telegrams from their respective areas and, by automatic switching, transmit the messages on to the area center of destination practically instantaneously. At the receiving end, manual operation of a push-button switchboard with over 200 destinations narrows down the receiving office to the nearest branch, the addressee's direct wire connection, or other delivery media. The telegram appears only twice as writing on a sheet of paper; once when it is received from the customer and again when it is readied for final delivery. The rest of the time the telegram appears in the form of paper tape, punched with holes which represent the stored intelligence in telegraph printer code.

While this highly mechanized system was being installed, transmission methods between offices were being improved. Instead of the direct-current magnetically operated lines and repeaters, most telegraph signals now are transmitted electronically over a frequency-modulated carrier—twenty channels are fitted into the spectrum required for a telephone or voice conversation and each spectrum channel delivers its own message to its own destination. These voice-bands can be obtained in groups by carrier methods over wires, cables, or microwave radio circuits. This apparatus and equipment is so efficient in operation, so fast and so accurate that Western Union is now handling over two-thirds of all rapid record communications.

Nor have the ocean cables been neglected in our continued improvements. An innovation rendering the older cables suitable for modern high speed service consists of a submerged electronic amplifier, which is placed in series with the cable on the ocean bottom about 150 miles out to sea. This repeater, powered from the shore end, intercepts the received signal in the quiet deep water and boosts it before it has had a chance to become too weak to overcome the noise it will pick up in its travel through shallow water to shore. This provides a clear, strong signal and enables us to triple the speed or word-volume capacity of the cable. Thus, with the expenditure of a sum small in comparison to the cost of several million dollars required to lay a new cable, we can rejuvenate an old slow one, making it capable of handling signals at modern speeds. In fact, some of the rehabilitated cables are expected to approach the speed of the most modern cables.

While improvements in the printing telegraph system continue, we are making truly phenomenal progress in "Telefax" or facsimile method of transmission. As a "record" communication company, we propose to accommodate records of any kind, anywhere, without reducing them to arbitrary telegraph codes which will print only in our English alphabet and require letter by letter hand typing. Facsimile will reproduce anything in black and white, manuscript or line drawings, using our proprietary dry recording paper, "Teledeltos."

We have used the "Telefax" to great advantage in telegram pick-up and delivery service to thousands of business houses in many cities, and thousands more are being installed now. Referred to humorously as "the electric messenger boy," our "Desk-Fax" transceivers, no larger than a portable typewriter, are used in thousands of business offices today all over the country. They provide what can be termed picture reproduction of telegrams from the customer to Western Union, and vice-versa, with easy facility. These little devices are so simple to operate that, as our president Mr.

(Continued on Page 24)

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Reviews of Technical Books

Power Stations

Steam Power Stations, by Gustaf A. Gaffert, McGraw-Hill Book Company, Inc., New York 36, N. Y. Fourth Edition, 1952. 627 pages. $8.00.

This widely adopted text has been regarded by teachers as one of the most useful books in the field of steam power stations. Brought up to date and revised for better instruction, this book is now available in the new fourth edition.

Primarily, this text's purpose is to make equipment, both major and auxiliary, familiar to students of Mechanical Engineering. The book reviews costs, performances trends in the direction of unit plant construction, as well as covering progress in design characteristics, arrangement of machinery, and many other alllied points.

This concisely written and well illustrated book covers just the steam electric plant. It is written in simple language which both the practising engineer and student can understand, and sketches, diagrams, graphs and tables are included to make the text even more easily understood.

Some of the chapter headings in *Steam Power Stations* are: Steam Engines, Steam Turbines, Heat Transfer, Condensers, Superheaters and Reheaters, Ductwork and Piping and Cycle Arrangement. There are also many others.

Irrigation Engineering

Irrigation Engineering, Volume I, by Ivan E. Houk, John Wiley & Sons, Inc., New York 16, N. Y. First Edition, 1951. 545 pages. $9.00.

tural and hydrological phases of irrigation in a comprehensive and up-to-date manner.

Volume 1 of *Irrigation Engineering* treats the agricul-

The author supplies helpful, practical data essential to engineers, agriculturists, and others interested in irrigation problems. The principles, facts, and practice of irrigation presented can be well utilized in the development of irrigation and in the maintenance of successful agriculture.

Special attention is devoted to recent advances in such subjects as soil moisture, wilting conditions, snow surveys, runoff forecasting, return flow, drainage recoveries, use of water by crops, irrigation efficiencies, quality of water, erosion during irrigation, and improved methods of applying water.

Brief summaries of the results of the more intensive field and laboratory investigations are given along with references to important source material.

Name and subject indices complete the volume.

Electrical Measurements

Electrical Measurements Manual, by Calon H. Dunn and Harlow J. Baker, Prentice-Hall, Inc. Publishers, New York 11, N. Y. First Edition. 1952. $4.35.

This manual is written as a text for an elementary course in electrical measurements. It is essentially a series of experiments designed to familiarize the student with (1) the types and characteristics of basic electric instruments and (2) the use of these instruments in the measurements of electrical and magnetic quantities. Many of these experiments are simultaneous studies of measurement technique and circuit theory. Each is preceded by a statement of the object, a brief discussion, and detailed procedure. Questions at the end of each experiment suggest important conclusions to be drawn by the student.

It is a well-balanced selection bridging the gap from simple ammeters and voltameters to oscilloscopes and vacuum tubes.

H.P.H., W.S.E.

Descriptive Geometry

Descriptive Geometry, by E. G. Pare, R. O. Loving and I. L. Hill, The MacMillan Company, New York 11, N. Y. First Edition, 1952. 309 pages. $4.00.

This text should give the student a well-rounded course in the graphic representation and solution of space problems. The material is divided into relatively short homogeneous chapters resulting in simplicity and convenience when the book is used for reference.

Problems are selected from all the engineering sciences: civil, mechanical, aeronautical, mining, electrical, architectural, and others. Apparently considerable care has been exercised to provide solution in pictorial form whenever they can be used to aid visualization.

At the end of each chapter are abstract and practical laboratory problems based on the text material just presented.

There are three appendices: (1) Graphical Accuracy, (2) Geometric Construction, and (3) Classification of Geometric Forms.

An adequate index completes the book.

H.P.H., W.S.E.

A Letter from Belgium

BRUXELLES, October 21st, 1952
3, RUE RAVENSTEIN (Hotel Ravenstein)

The Western Society of Engineers
84 East Randolph Street
Chicago 1, Illinois

Gentlemen,

The Delegates of our Society, Members of Engineering Study Team OEEC-2-108, now back in our Country, have reported on the interesting and friendly welcome they enjoyed in Chicago during the Centennial of Engineering.

The opportunities afforded them of meeting their American colleagues will no doubt promote a better understanding and cooperation between Engineers.

We therefore feel it our duty to express our thanks to you and to the Members of your Staff for all you have done for the success of the Celebrations in Chicago.

Yours faithfully,
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Secretary to the Board.

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(Continued from Page 21)

Marshall remarked, "Even the boss can work it."

In Baltimore, we are carrying on an experiment in telegraph delivery which we feel is the forward approach to better telegraph service to the residential user. The scheme involved is an extension of our Telefax facsimile system to mobile branch offices in automobiles, called "Telecars." Equipped with two-way radio, each "Telecar" cruises in a specified suburban area, automatically receiving telegrams in picture form from a central facsimile bureau in our main office, through remote-controlled fixed radio stations. Telegrams, for points within a Telecar's designated cruising area, are automatically received by the facsimile apparatus in the Telecar even while the car is in motion toward a delivery point. Answers to the telegrams can be flashed back to the main office from the car by return radio connection. The Baltimore installation has expanded from an initial single car and one fixed station to seven care and four fixed radio stations. The new front door telegraph office on wheels seems assured of success.

Still under development but already in restricted traffic service, we have the "High Speed Fax." This facsimile equipment can reproduce an entire letter-size page of writing or diagrams in half a minute. Two transmitters are used alternately, because the transmission is so fast, to permit one to be loaded while the other is transmitting. The automatic recorder cuts off and ejects the received copy without assistance. With the great speed of 3000 words per minute, faster than speech, the High Speed Fax is hailed as the "communication marvel of tomorrow."

While improving our facilities for telegraph traffic we have at the same time brought the improvements in high-speed switching arrangements to a number of industries who operate their own private wire systems. Thus with our automatic telegraph reperforation equipment we furnish a leased service, like a small telegraph company within itself, to a number of customers. Largest of these include the U.S. Air Force, U.S. Steel, General Electric, United Air Lines, Kaiser Industries, Sears Roebuck, and almost all of the large banks in the country.

Of course, in addition to the large leased reperforator systems, there are numerous smaller ones and a whole host of leased wires used by customers to direct stock-brokerage businesses, trucking lines, and miscellaneous warehousing systems. The development of automatic bookkeeping and accounting machines operable by the same type of perforated tape used for our telegrams has opened up a large field for the transfer of information in condensed form over telegraph wires.

Our latest development to speed up intra-company communications and thus improve the efficiency of all lines of business is the "Customfax," an adaptation of our Desk-Fax message distribution system. Utilizing facsimile equipment which has already been received with great enthusiasm by business men for telegram transmission purposes, the "Customfax" apparatus can be assembled in sections to take care of large or small installations, to interconnect many offices or a few. Operated with extreme simplicity by employees of the subscriber, this type of equipment is in use by banks to verify signatures in central files for branches; by stores transmitting facsimiles of the original sales tickets to order delivery of goods from warehouses to customers, by air lines to handle recorded information between offices and air-field centers; and for other purposes where quick and accurate written or diagrammed information is essential. The uses in which "Customfax" will be valuable seem almost limitless.

In connection with the general transmission of records without physical transfer of material, we are currently working on a facsimile scanner that will enable distant copying of records stored in vaults or in libraries without removing the pages from their binders.

Wherever the need for record communication arises, Western Union has devised means for its accomplishment by telegraphic methods. We have thus literally "grown up" with the country as the requirements of commerce have expanded from border to border and from sea to sea. Our operations have increased in complexity and scope in step with the tempo of technology which has caused us to successively overcome competition from the stage coach, the "Super Chief," and "Flight 99." We expect to meet with atomic-powered devices any day and will

be ready, as always, to keep up our end of the bargain.

In the time of Samuel Morse, communications were just beginning to develop beyond the man-power stage. Much of his early devlopment work was carried on in New York University on Washington Square, commemorated by a plaque. Were Morse to stroll on MacDougal street today, as he undoubtedly did in the past, he would see a view of the Empire State Building tower with its prophetic spire carrying TV and FM antennae almost a quarter-mile above the street. Once again he could marvel at the developments his telegraph presaged. If he could but see the electronic wonders of the telegraph industry today, I feel sure he would repeat the immortal phrase of the first telegram—"What Hath God Wrought?"

Warns of Impact of Atomic Energy

The utilization of atomic energy is so close that businessmen were warned Sept. 11 to be alert against the danger of getting caught with obsolete plants, processes and products.

The warning came from P. J. Lovewell, assistant chairman of the department of industrial economics at Stanford Research Institute, Stanford, Calif. Mr. Lovewell was one of ten speakers participating in a comprehensive symposium on the industrial applications of atomic energy staged as part of the seventh National Chemical Exposition of Chicago by the Chicago section of the American Chemical Society.

Potential developments in atomic power, Lovewell said, are bound to have eventually a major impact on practically every segment of business and industry, with manufacturers and processers and power utilities first affected.

"The introduction of atomic power and processes sired by the atomic energy program may begin on a modest scale within five years," he predicted. "In ten to twenty years, the effect on business would be sufficient to be generally felt."

Management's problem now, Lovewell continued, is to keep informed as to developments affecting plans and to maintain research programs to protect their competitive interests. Present knowledge must be taken into account in all long-term plans.

"Managements need have no fear that foreseeable developments from atomic energy will replace the economic need for their respective products and services, as the electric light replaced the gas jet," Lovewell said.

"Businessmen must remain alert, however, not to be caught with obsolete plants, processes or products that place them in an untenable competitive situation."

Present technical developments which will affect business fall into three types, Lovewell said.

First he mentioned the definite possibility of heat-producing atomic reactors for the production of power. This is "perhaps only four to five years away, measured in terms of full-scale producing units," he said.

"Certainly in an industrial economy," he said, "nothing is more vital than power supply. The introduction of a vast new potential in power supply, using a fuel so light and compact as to be readily and economically transportable, even to distant locations, could have an almost revolutionary effect on our economy generally and even the remote possibility of such a thing can well have its effect on the plans of individual businessmen today."

Second, Lovewell continued, there is the potential industrial application of the radioactive by-products of fission now stored as wastes. In five years, studies he cited have shown, such commercial applications are possible as high-speed, low-cost industrial radiography and the heatless sterilization of food and drugs. Beyond those lie such developments as portable low-level power sources, improved propagation of flame as in internal combustion engines, the activation of chemical reactions and many more.

Finally, Lovewell said, there is the use of radioisotopes, already progressing rapidly. These are chemically pure radioactive forms of various elements, made in the atomic pile or separated out of the reactor wastes. They are being used in instruments such as thickness and liquid level gauges and density meters, and for activation of phosphors and for static elimination, and in another form as tracers to permit scientists to trace atoms tagged by radioactivity through various processes, industrial or physiological.

There are many other problems raised by these future hopes, Lovewell said—safety of workers handling radioactive materials, insurance coverage, patent rights and know-how protection, public relations in overcoming fear of atomic energy rooted in its military uses, shipping and waste disposal, and relations with government, which controls all atomic energy.

Lovewell complimented the Atomic Energy Commission for its relative lack of red tape and pointed out that, though it has a complete monopoly, "its administration has been distinguished by an all-out use of private enterprise."

"Also important, however," he said, "is the fact that the AEC has been successful in attracting commissioners and other key employees of unquestioned ability. These men, many of them new to government service, have made a real contribution to national welfare by keeping the philosophy of private enterprise alive in the huge and vital atomic energy program."

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Castable Refractory Use Growing

The rapid adoption of castable refactories in place of fired refractory shapes for furnaces commonly used in the manufacture and processing of steel has been a significant postwar trend. This was brought out by J. D. McCullough, chief engineer, Refractories Division, The Babcock & Wilcox Company, in a paper given before the Association of Iron & Steel Engineers in Cleveland on October 1, 1952. Refractories are heat resistant materials used to line industrial furnaces.

"A castable refractory—often referred to as a refractory concrete—is shipped dry; water is added at the job site and the material is mixed and placed in a manner similar to structural concrete," he explained. "Because of a chemical reaction between the water and binder, it develops a very high air dried strength, which may increase with time. It does not require exposure to heat in order to attain a high strength."

Mr. McCullough attributed the trend toward the use of castables to a shortage of skilled masons, the reduction of inventory of special shapes, elimination of expensive cutting and fitting of brickwork, savings in time and cost of installation, lower maintenance, and the availability of improved volume-stable refractory castables suitable for temperatures up to 3000 degrees F.

Castables can be poured into place or shot into place by a suitable type of gun. If poured, they can be mixed by hand or can be mixed in a cement mixer or a mortar mixer. Economic considerations and availability of equipment should determine the method, he said.

Typical Applications

Mr. McCullough cited a group of typical installations which were made with a volume-stable 3000F. kaolin base castable characterized by a high alumina-low iron hydraulic binder which has proved itself unaffected by high sulphur fuel and reducing atmospheres. These installations included soaking pit covers, soaking pit walls, high thermal head furnaces, cartops, burner blocks, billet and slab heating furnaces; and such standard applications as door linings for all types of furnaces, flat precast lintels over slot type openings, nose arches, and locations normally requiring much cutting and fitting when regular fired brick is used.

Soaking pit covers frequently require a great amount of maintenance because of unusual stresses, the way handling equipment is operated, or age of equipment. For these and other reasons refractory maintenance costs with conventional constructions have become so critical in many plants that a departure from conventional methods of construction has had to be considered. In one mill, monolithic construction was tried and was successful in reducing maintenance. The use of refractory castables sped up installation from 1.3 to 6.5 square feet per man hour.

Soaking pit walls are also a source of high maintenance in many plants. This can be due to ingots striking the walls, resulting in immediate gouged areas and resultant loosening of brick; sand from the seals working down through the brick joints, resulting in separation of brick; alternate heating and cooling of the brick, resulting in working them out of place; or a combination of the foregoing, with other causes contributing to a relatively short life. A monolithic construction eliminates many of the weaknesses mentioned, and a castable refractory lends itself to easy, economical, and rapid installation of a monolithic construction.

In recent years, the principle of rapid heating of billets and tubes by means of high thermal heads has gained increasing acceptance, he revealed. The linings of such furnaces, usually circular in cross section, present a tedious job of cutting and fitting of brick, particularly around burner blocks. The use of castables eliminates this problem.

Article Lauds WSE, Other Societies

For those persons who attended the Centennial of Engineering, there is a splendid article covering the Centennial in the November, 1952 issue of Mechanical Engineering, official publication of A.S.M.E.

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R-9356 ARCHITECTURAL ENGINEER. Age: 30-45. 5 yrs. exp. constru. and design. Some supervisory exp. Knowledge of modern shop practice. Duties: design supervision in structural metal trim fabricating. Interpret architects' specifications, plan and supervise work in design stages. For a manufacturer and warehouser of sheet metal products. Salary: $6000-$7500. Employer will negotiate the fee. Loc.: Midwest.

R-9353 CHEMICAL ENGINEER—Chem. Eng. Recent graduate or better. Duties: make physical chemical and metallurgical analysis of materials. Also develop special processes. For manufacturer of telephone equipment. Salary: up to $400 per month. Employer may negotiate fee. Loc.: Chicago.

T-9352 ELECTRICAL PROJECT ENGINEER—10 years plus in electrical inside industrial wiring and con rol work. Must be good organizer and administrator. Duties: project manager on heavy industrial wiring and may supervise up to 1000 men. F.B.I. clearance required. For a contractor. Salary: $15,000 to $20,000. Employer will negotiate fee. Location: Ohio.

R-9351 DRAFTSMAN—Recent Graduate or better. Know. of ornamental iron. Duties: drafting on ornamental iron and miscellaneous iron work. For a manufacturer of ornamental iron. Salary: up to $120 per week. Employer will negotiate fee. Location: Chicago.

R-9347(b) CHEMICAL ENGINEER. Chem. or Chem. Eng. Age: up to 30. Recent Grad. or better. Duties: training in paint laboratory and then outside sales work selling maintenance paints. Salary: $350-$500 per month. Employer may negotiate fee. Location: Chicago.

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WSE Applications

In accordance with the By-Laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Associate, Member, Affiliate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admissions, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office, 84 E. Randolph St., RAndolph 6—1736.

52-52 Frederick P. Boulias; Standards, Analyst I, Campbell Soup Co., 2550 W. 35th St.

53-52 Charles C. Quackenbush, Traffic Engineer, Illinois Bell Telephone Co., 212 W. Washington St.

54-52 Otho V. Tally; Manager, Midwest Region, AllisChalmers Mfg. Co., 135 S. LaSalle St.

55-52 Russell C. Kremer, General Commercial Engineer, Illinois Bell Telephone Co., 111 N. Franklin St.

56-52 George P. Vincent, Design Engineer, E. R. Gritschke, 11 S. LaSalle St.

57-52 Lotan C. Read, (Rein.), Tool Eng. Design, Kaiser Manufacturing Corp., S. 14th St., Richmond, Calif.

58-52 E. Allan Bailey, District Manager, J. F. Pritchard & Co., 205 W. Wacker Dr.

59-52 Augusts H. Tolks; Designer, Checker, J. Meissner Cons. Eng., Inc., 308 W. Washington St.

60-52 Ralph G. Owens; Dean of Engineering & Prof. of Mech. Eng., Illinois Institute of Technology.

Society Secretaries Meet in Chicago

The Council of Engineering Societies Secretaries held its sixteenth annual meeting at the Hotel Sheraton during the Centennial of Engineering in Chicago, Ill. The meeting was held Sept. 12-13, 1952. This organization is composed of secretaries of local, state, and national engineering societies and members of their staffs.

The purpose of the meeting, in addition to furthering the acquaintance which exists between the secretaries from various parts of the country, is to avail the secretaries of an opportunity to exchange ideas regarding the management and operation of engineering organizations.

There is a nominal fee for membership in this organization which is used to defray the expenses of producing the printed copies of the program and minutes and their mailing.

The program for the meeting at Chicago was highlighted by talks and round-table discussions on subjects such as Tax Problems; Engineering Manpower, by T. A. Marshall, Jr., Mem. ASME, executive secretary, EJC Engineering Manpower Commission; An Engineering Societies Library, by Ralph H. Phelps, director, Engineering Societies Library, New York, N. Y.; Unity, by Titus G. LeClair, WSE, vice-president, Commonwealth Edison Company, Chicago, Ill.; Raising Funds for An Engineering Society or Club, by R. H. Bacon, Mem. ASME, WSE, president R. H. Bacon & Company, Chicago, Ill.; Engineers' Council for Professional Development and Their Training Program, by Cornelius Wandmacher, professor of civil engineering, University of Cincinnati; How to Plan For a Committee Meeting or Conference, Relations Between Local and National Engineering Societies, by O. Laurence Angevine, secretary, Rochester Engineering Society; and Engineering Societies Personnel Service—And How to Keep Engineers Employed Through Its Branch Offices, by Alfred H. Meyer, director, Engineering Societies Personnel Service, discussion led by J. Earl Harrington, secretary, Western Society of Engineers, Chicago, Ill.

The Council of Engineering Societies Secretaries accepted the invitation of the Engineers' Club of Philadelphia to hold its 1953 meeting at Philadelphia on Friday and Saturday, June 5-6.

The officers elected for the coming year are: President, Henry S. Harris; Mem. ASME, Engineers' Club of Philadelphia, Philadelphia, Pa.; vice-president, Ernest Hartford, executive assistant secretary, ASME, New York, N. Y.; secretary, Frank G. Horton, The Engineering Society of Detroit, Detroit, Mich.; treasurer, M. C. Turpin, The American Society of Refrigerating Engineers, New York, N. Y.; director for one year, Edward H. Robie, The American Institute of Mining and Metallurgical Engineers, New York, N. Y.; director for two years, Henry H. Henline, American Institute of Electrical Engineers, New York, N. Y.; director for three years, J. Earl Harrington, Western Society of Engineers, Chicago, Ill.; and director for one year, Col. William N. Carey, American Society of Civil Engineers, New York, N. Y.—From Mechanical Engineering, November, 1952.

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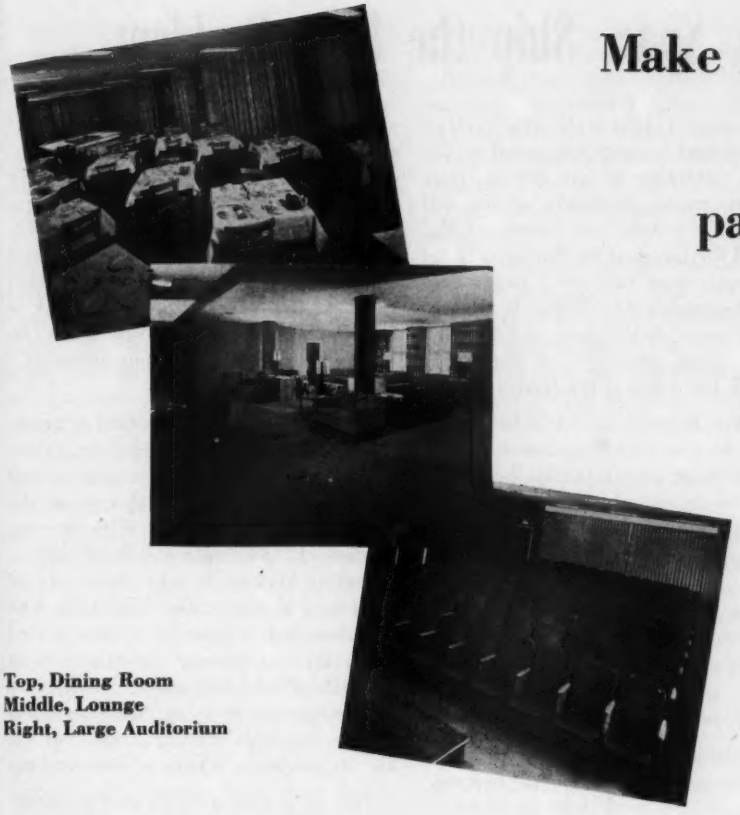

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Engineers with Ideals the Need of Civilization

The future of civilization depends on engineers with ideals, who respect the rights of others and appreciate the meaning of liberty, Dr. Andrey A. Potter, dean of engineering at Purdue University and president of Bituminous Coal Research, said October 31 in an address before the 15th Annual Fuels Conference of the American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers at the Bellevue Stratford Hotel in Philadelphia.

"The American engineer can set an example to others by assuming his full responsibility as an intelligent and patriotic citizen for maintaining our type of government, which has emphasized the rights of the individual above those of the State, and which has made possible for us living standards unknown in other lands at any time in human history," Dr. Potter stated.

Because of his responsibility, the engineer's education is of major concern to the public, he said, explaining that "engineering education in this country rests on a foundation of science, of humanities, and of social relationships. Our engineering college graduates are making contributions where science is applied to the problems of industry, commerce, and public works, and where work must be organized systematically with due regard to human values, as well as to costs and returns."

American industry has long recognized the value of engineering. "This is evidenced by the fact that while our population has hardly doubled during the past 50 years, our engineers have increased by more than 13 times," he pointed out. "Yet, in spite of the rapid growth of the number of engineers in this country, we are now facing a shortage of engineers. This is partly due to the growing demand for people with an engineering background in fields outside of industry and public works, partly to the small number of high school graduates who have taken up the study of engineering during the past two years, partly by reason of the short-sighted policy of our so-called 'Selective Service,' and also by reason of the fact that industry is not making the best use of the engineers.

"Americans, more than any other people in the world, have 'the will to have,' and are willing work hard in order to satisfy their wants," Dr. Potter asserted. "Our industrial progress may also be attributed to the fact that Americans, more than any other people in the world, encouraged by our type of government, have excelled in inventiveness. More than half of the epoch-making inventions of the past century may be traced to American creative genius, which has definitely extended gainful employment, while providing new comforts for humanity."

As the forward pace of industrial development quickened, the ingenuity of the individual inventor had to be supplemented by organized research sponsored by industry, trade associations and other engineering and educational groups, according to the speaker. "Nearly half of the total employment in this country is based on the products coming from the research laboratory, and each research man provides employment for about 200 other persons. Industries that have made the most spectacular growth during the past 30 years and which have weathered best the difficult period of the 1930's, are also foremost in research," he said.

Space Ship the Easy Problem

Providing a vehicle to reach other planets would be easy compared to the task of sustaining human life in interplanetary space, engineers at the fall meeting of the American Society of Mechanical Engineers at the Sheraton Hotel in Chicago were told in a paper presented September 9 by Milton W. Rosen, head of the rocket section and Richard B. Snodgrass, physicist, of the Naval Research Laboratory, Washington, D. C.

While it is much too early to discuss specific designs for manned satellites and space vehicles, (for scientists have only started to investigate the problems involved in maintaining human life outside the earth's atmosphere), the authors stated that, based on the present rate of progress in sounding rocket research, single stage rockets may be expected to exceed 500-mile altitudes and multi-stage rockets, 1,000 miles within the next five years. "Sounding rockets are the ancestors of future space vehicles, but not the immediate ancestors," they added.

Although the rocket was used as a military weapon back in 3,000 B.C., its use as a research instrument is quite recent and starts with the development of the liquid-propellant rocket. With the exception of the German V-2, high-altitude sounding rockets in use today are of American design. The Wac Corporal, Aerobee and Viking have transported seven tons of scientific instruments to altitudes 40 and 140 miles. Twenty tons of instruments were carried to similar heights by V-2's during a six-year research program which is now ending.

One of the most important problems connected with the use of sounding rockets for upper-air research is the recovery of data. Radio telemetry has been the most common means of reading the various instruments carried in the rocket and recording the data they yield, it was explained. The readings are converted to electrical voltages and are broadcast from a rocket-borne transmitter to receiving stations on the ground, where they are automatically recorded. Various rocket functions, such as control-vane position, turbine speed, and combustion chamber pressure are also recorded in this way. The severe restrictions imposed on the weight of the rocket-borne transmitter, the signal attenuation and modulation due to ionnzation in the exhaust stream, and the effect on signal strength of the rocket's attitude, all contribute to the complexity of the telemetry problem.

Some measurements cannot be telemetered and must be recorded within the rocket, on photographic film, radiation sensitive emulsion, magnetic tape; or in the case of biological specimens, within the cell structure of the organism. The recording medium must be physically recorded from the body of the rocket

after it lands or from a part of the vehicle that has been separated in flight. Small rockets, such as the Wac Corporal, have been recovered intact by parachute.

In the case of V-2's and Vikings, which reach altitudes where no type of parachute would be effective, the airframe is severed into two or three parts, by means of explosives, as it reenters the denser portion of the atmosphere, thereby eliminating the explosive impact that would otherwise pulverize the vehicle. This technique has made it possible to obtain photographs of the earth, solar spectra, and cosmic ray emulsions from the highest altitudes attainable.

"The possible erratic flight of a rocket is a problem of grave concern to the proving ground which is responsible for ensuring that all rockets land within the range. When a rocket turns toward the range boundary, it is observed by radars and optical instruments which have been tracking it continuously. The outputs of these instruments are fed to a computer which predicts where the rocket will land if its powered flight is terminated instantly. When it is established that a given rocket is unsafe, a radio signal is sent to the rocket, where it shuts off the power plant. The rocket continues from this point like an artillery shell to an impact location determined by its velocity and trajectory angle at the time of cutoff. Previous sounding rockets have been constrained to their trajectories by aerodynamic forces and internal controls. There was no guidance from the ground. Newer Vikings are equipped with a radio command system which will turn the rocket toward the center of the range when it starts to deviate," the paper said.

Photographic records from several large tracking telescopes on the ground give a continuous history of the rocket's attitude or orientation in space, it was brought out. "But even to a telescope, the rocket at a hundred miles gives an exceedingly small image. The earth, on the other hand, is a very large object when viewed from a rocket several hundred or even a thousand miles up. It is possible to completely define the rocket's orientation from a photograph taken by a camera in the rocket, if the photograph shows the earth's horizon and a recognizable landmark of the image of the sun. This technique was used successfully in the 136-mile Viking flight when a rocket-borne movie camera took 2,000 pictures of the earth in six minutes. Other rocket-borne instruments have been used to determine altitude with varying degrees of success. These include photocells to detect the angle of the sun, bolometers to detect the earth's horizon at night, and rotating coils to indicate the rocket's orientation relative to the earth's magnetic field."

For some high altitude research, such as solar spectroscopy, the rocket must be restrained to a given orientation during its coasting flight. The Viking is the first sounding rocket to attempt this task, using gyroscopes which control small rocket motors that provide correcting forces.

The possible damaging effect of rocket motor vibration on instruments and on the structure itself must be considered in developing any sounding rocket, the authors warned. However, the fact that many tons of delicate physical and electronic equipment have been successfully flown in rockets testifies that this problem can be overcome.

Future Possibilities

Altitudes which future sounding rockets will attain will come about through improvements in motor efficiency and weight efficiency, (known in rocket terminology as specific impulse and mass ratio), the authors asserted. The newer chemical propellants, thus far restricted to the laboratory, will find application in flying vehicles. Combustion pressures will increase through the use of materials having high strength at elevated temperature and novel techniques for cooling the walls of rocket motors. The use of lighter metals and plastics, and new techniques of construction will bring about improvements in weight efficiency.

Atomic energy as a power source for rocket propulsion is important, but its value has been overestimated, according to the authors. "There is a practical limit on the temperature at which a rocket motor can operate and it matters little whether the heat has been generated by nuclear or molecular reactions. All rockets have to carry a working fluid. This fluid can have lower molecular weight than the exhaust gases of a chemical combustion and herein lies the major gain to be achieved from the use of a nuclear power plant. The protection of instruments and personnel against damaging radiation is an obstacle to be overcome."

The Need, Research on Research

More research on how to do scientific research was urged October 1 by Dr. Haldon A. Leedy, director of Armour Research Foundation of Illinois Institute of Technology in Chicago.

Speaking at the engineering management session of the National Electronics Conference at the Hotel Sherman, Dr. Leedy said research managers generally must rely on their own experience in setting up effective research programs and administrative procedures.

"But," he added, "the fact that more articles and books on the subject are appearing is a heartening sign that managing research is becoming a recognized professional activity, just as performing research has long been recognized."

During the current year, research managers will handle $2.9 billion research and development dollars, directing the work of 350,000 persons in laboratories valued at $4 billion, according to Dr. Leedy.

"Thus," he continued, "the man who can plan a project, handle personnel and budget problems, explain his case clearly to top management, and push an operation to success is a real asset. Finding and developing such men is essential if research is to continue as a major force in the advancement of our way of life."

Dr. Leedy said the nation's research administrators are developing improved ways to handle research and to utilize the talents of research workers.

Scientists also will be called upon to supply some of the answers. For, as Dr. Leedy put it, management of research, being a relatively new field, is a kind of pioneering, involving the complexities of big business plus the problem of conducting organized research in the most efficient manner.

"As consumers demand ever higher quality, as National Defense requirements become increasingly complex, and as science itself advances into more difficult fields, an increased number of research and development problems will come to the laboratories," he said. "Better management will result in better research."

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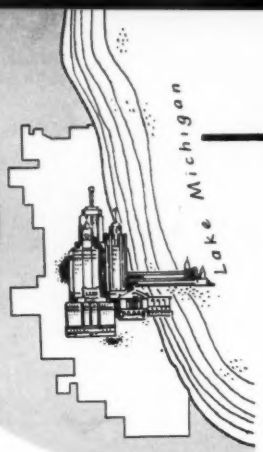

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